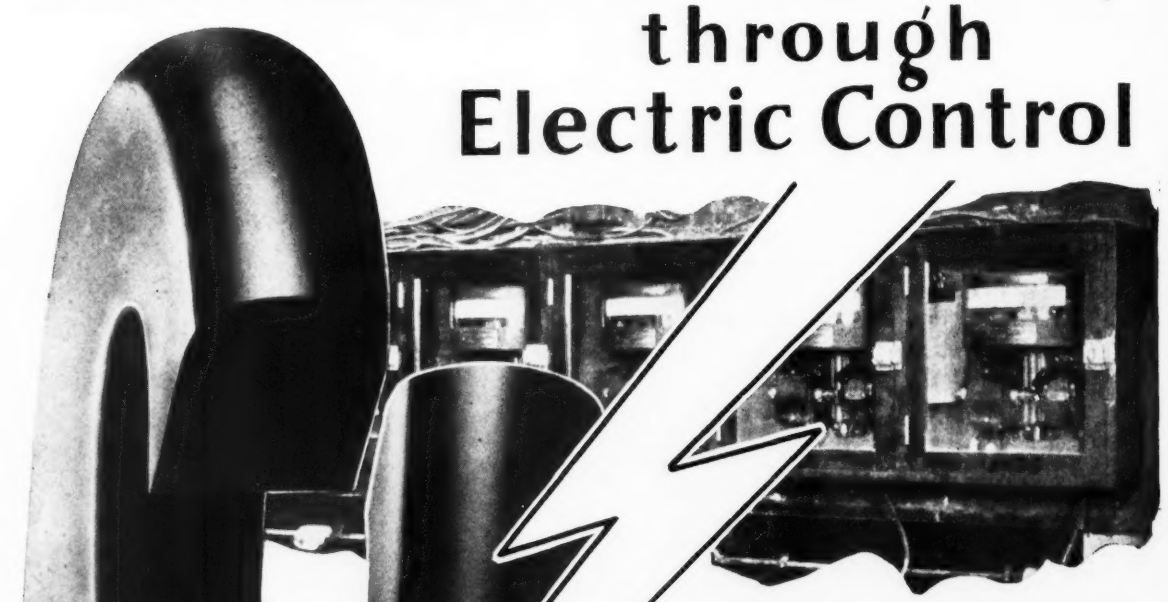
Railway Engineering and Maintenance

FAIR Rail Anti-Creepers are
giving dependable service
ALL OVER THE WORLD.

Their widespread use is proof
of exceptional merit.

CHICAGO THE P. & M. CO. NEW YORK

Consistent Uniformity through Electric Control



DURING the heat treating process of Hy-Crome Spring Washers nothing short of Pyrometer accuracy is permitted to safeguard their consistent uniformity.

First made brittle hard they are slowly tempered to that all important degree of "just enough tension" through the absolute certainty of scientific heat control.

Through every step of Hy-Crome manufacture the risk of human error is eliminated wherever possible. It is these exacting methods which insure the guaranteed reliability of Hy-Crome performance making them an outstanding product in the sense of service and economy through their unfailing ability to indefinitely maintain permanent bolt tension.

THE RELIANCE MFG. CO.
MASSILLON, OHIO

NEW YORK, CLEVELAND, DETROIT, CHICAGO, ST. LOUIS, SAN FRANCISCO

M. S. Kenney, Munsey Bldg., Baltimore, Md.
W. & A. C. Semple, Louisville, Ky.
Engineering Materials, Ltd., McGill Bldg., Montreal, Quebec, Canada

HY-CROME
SPRING WASHERS

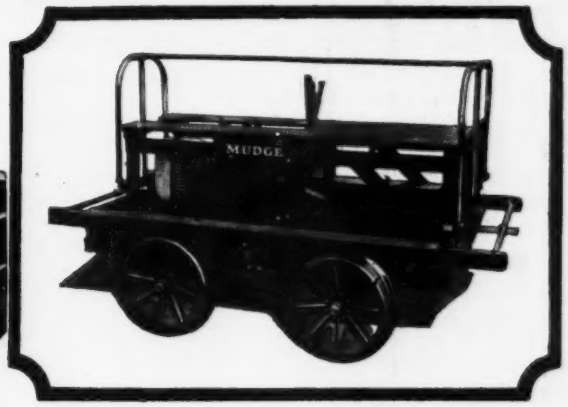
RAILWAY ENGINEERING AND MAINTENANCE
Published monthly by Simmons-Boardman Publishing Co., at 608 S. Dearborn St., Chicago. Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00 a year. Single copy, 35 cents. Entered at Chicago, Ill., as second-class matter.

Alphabetical Index to Advertisers, Page 72

Classified Index to Advertisers, 68-70

As easy as raising the hood of an automobile

Tilting the top on this Mudge Class WS-2 Motor Car exposes the complete power plant. Every part is instantly accessible for inspection, adjustment and repair. One man can work on this car easily.



THIS labor and time saving feature was originated by Mudge engineers in line with the company's policy of providing very practicable improvement in motor cars. It is an exclusive feature embodied in both the WS-2 standard section car and the WS-3 heavy duty car.

Mudge Cars are noteworthy for the practical character of their special features. No frills are added just to provide a talking point. A Mudge design can be recognized by its basic simplicity, ruggedness and all around dependability.

Mudge Cars seldom need attention but even this emergency is provided for in the simple arrangement illustrated above.

We manufacture a complete line of railway inspection and section cars; side drive or center load; direct connected or free running; air-cooled or water-cooled motors.

Mudge & Company

Manufacturers—Railroad Equipment
Railway Exchange Bldg. • CHICAGO

REM7-Gray

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Railway Engineering and Maintenance

Formerly the Railway Maintenance Engineer

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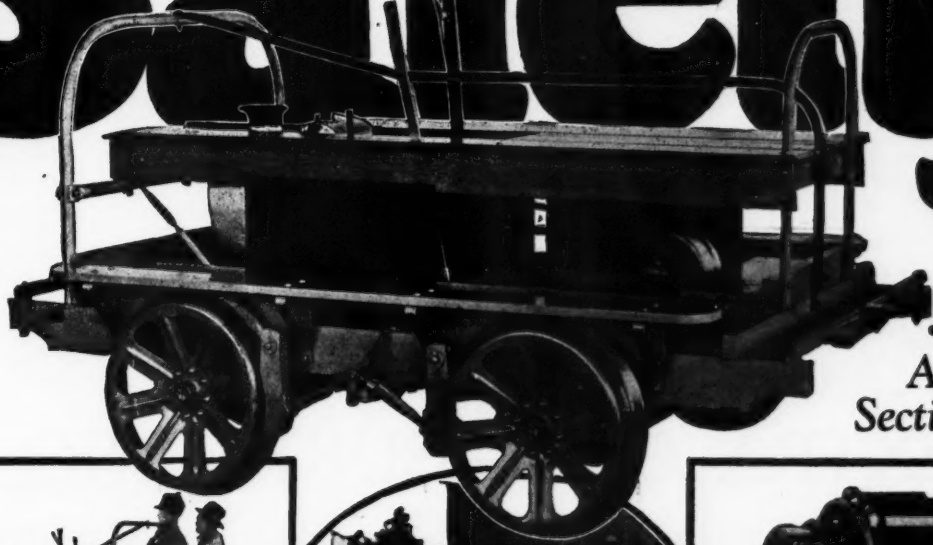
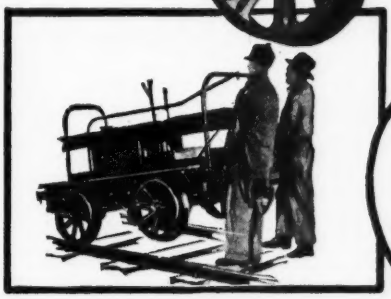
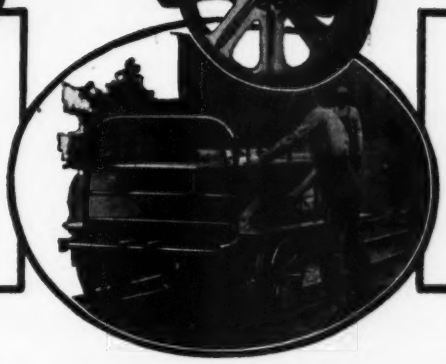
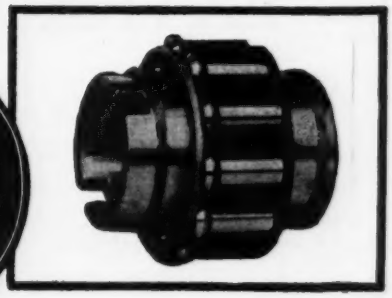
Safety



A2
Advance
Section Car







in More Ways Than One

1—High Safety Rails at each end. Center Grab Rail makes men in center as safe as those at both ends. 2—Quick stopping, adjustable four-wheel brake controlled by centrally located lever which cannot be blocked by tools. 3—Started by cranking—no pushing followed by a sudden start and dangerous scrambling to get on. 4—Deep tool trays on each side securely hold longest track tools. 5—Reversible engine gives choice of setting-off places. 6—Lift pipes and light engine make removal from track easy. 7—RINGSEALD Roller Bearings cannot cut the axle. 8—Safer wheels—press fit, non-corrugated hubs—rivets stay tight.

FAIRMONT RAILWAY MOTOR CARS

Inspection—M19

Light Section—M14

Section { A2 / M2 / S2

FAIRMONT RAILWAY MOTORS, Inc., Fairmont, Minnesota

District Sales Offices: NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO WASHINGTON, D. C. NEW ORLEANS WINNIPEG, CANADA

BALDWIN LOCOMOTIVE WORKS, Foreign Representatives

Fairmont

RAILWAY MOTOR CARS

Performance on the Job Counts

EXTRA GANG SURFACING

When surfacing operations are handled by extra gangs, it is possible to increase the feet of completed track from 2 to 3 times over ordinary methods by providing the outfit with proper Electric Tamping Equipment.

A gang of from 35 to 40 men using 16 Jackson Electric Tie Tampers (two standard L-2 8 Tamper plants) has proven to be a most efficient organization for this class of work.

Not only is the maximum footage of completed track per man obtained, resulting in early completion of the work, but costs are correspondingly reduced.

The greatest saving, however, lies in the permanency of the track.

If you are not maintaining your surfacing schedule, we will gladly demonstrate how it may be done.

ELECTRIC TAMPER & EQUIPMENT CO.

80 EAST JACKSON BLVD. CHICAGO, ILLINOIS

A BIG LOAD

A Hyatt equipped Casey Jones motor car hauling four Hyattized trailers and push car with 125 men and materials.

But easy for Hyattized Casey Jones

When the Northwestern Motor Company of Eau Claire, Wisconsin, builders of "Casey Jones" motor cars, trailers and push cars, standardized on Hyatt Roller Bearings, they gave further meaning to their trade mark legend "Strength, Simplicity and Dependable Service."

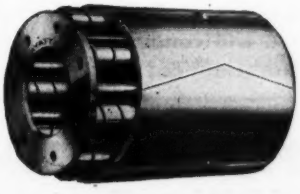
In their legend is summed up the essence of Hyatt advantages in railway maintenance car construction.

Strength is built into the sturdy Hyatt rollers to carry heavy loads — simplicity is demonstrated in their convenient mountings—and dependable service is a matter of record in the thousands of cars that are operating on these better bearings today.

Freedom from constant oiling, longer lived cars, gasoline savings, and avoidance of delays are made possible by their use. Specify Hyatts on all orders for new cars. For your present equipment Hyatt replacement boxes are available.

Hyattized cars or Hyattized replacement boxes are available from the following manufacturers:

Buda
Fairbanks-Morse
Fairmont
Kalamazoo
Mudge
Northwestern
Sylvester



HYATT ROLLER BEARING COMPANY

Newark Detroit Chicago Pittsburgh
Worcester Philadelphia Oakland Cleveland

HYATT

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

Casey Jones

BALLAST DISCER

OPERATED BY Casey Jones 551

EQUIPPED WITH STANDARD FORD MOTOR

BEFORE

Numerous Uses

Ballast agitation and drainage—Shaping the shoulder to desired contour—Establishes a perfect grass line—Operates in all kinds of ballast—Improves the general appearance and condition of the right of way—Ballast removal—Weed destruction—Shaping new ballast.

NORTHWESTERN
General Office - Factory

WEED DESTRUCTION-BALLAST

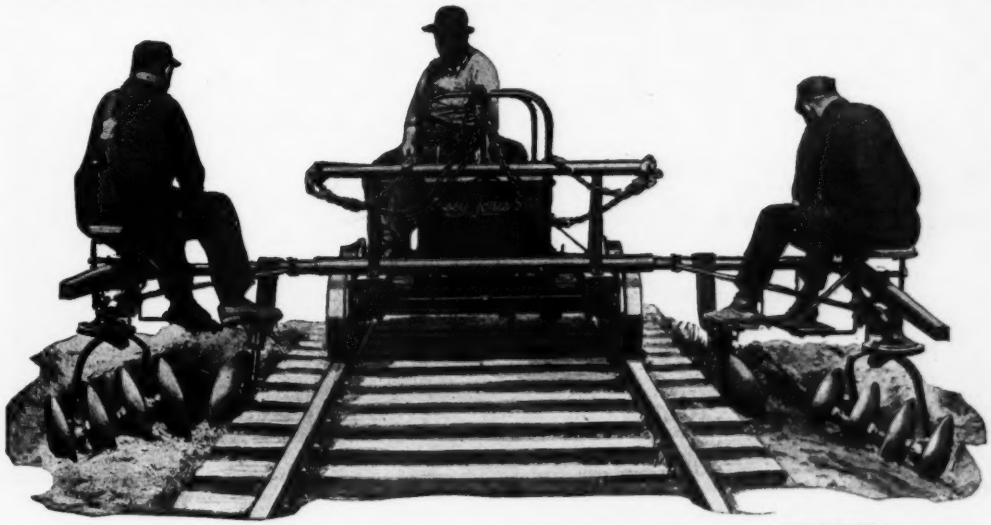
mes 580

REG. U.S. PAT. OFF.

WEED DESTROYER

HEAVY DUTY MOTOR CAR

AND AUTOMOTIVE ALL-GEAR TRANSMISSION



AFTER

Inexpensive Service

Small investment and low cost of operation per mile —Standard Ford motor and service—Standard discer parts—Lasts several years—An all purpose extra gang motor car—Operates weed mowing machines with ease.

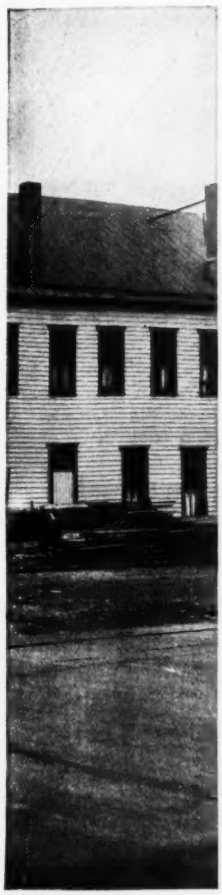
MOTOR COMPANY
EAU CLAIRE, WISCONSIN

DRAINAGE ——→ 77¢ A MILE

This low-maintenance is an

The maintenance cost of this modern crossing will be practically negligible, for it's protected indefinitely by Carey Elastite Preformed Track Pavement.

crossing investment in good-will



THIS crossing has seen months of heavy service under temperatures ranging from far below zero to higher than 100° F; yet its condition today is as satisfactory as when it was installed!

That's because it's made of Carey Elastite Preformed Track Pavement, which knits and heals under traffic. The installation cost was moderate, and maintenance cost will be negligible, for there'll be no expensive patching.

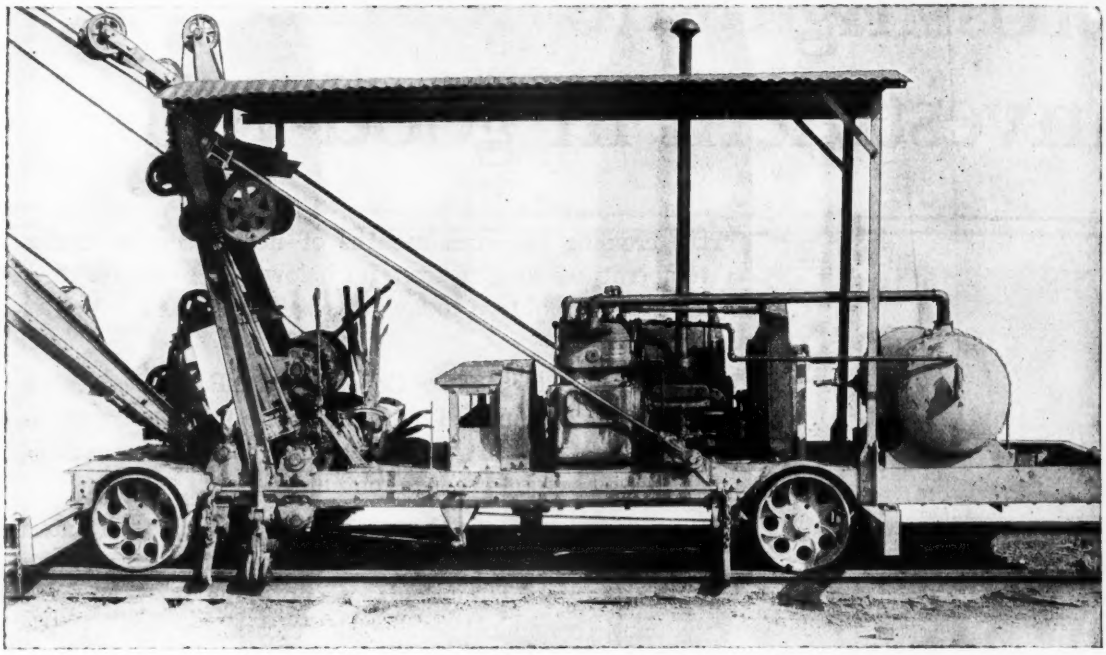
Smooth, weatherproof—the modern crossing made of Carey Elastite Preformed Track Pavement constantly attracts the favorable attention of hundreds of approving motorists. In good-will and economical service, this crossing repays its cost many times over. Write at once—we'll be glad to answer your questions about this remarkable crossing pavement.

Carey Elastite Preformed Track Pavement consists of slabs about two inches thick and sections of rail filler, both made of a fibrous, asphaltic material that knits and heals under traffic. Through the use of this modern improvement, tracks and pavement move as a single unit under traffic impact—a unit which readily adjusts itself to traffic over the tracks and the highway.

THE PHILIP CAREY CO.
Lockland, Cincinnati, O.

Carey Elastite
PREFORMED
TRACK PAVEMENT

"Knits and heals under traffic"



This close-up side view of the Parsons Crane shows the compression equipment, also the ballast rack at extreme right, which permits the operator to adjust counterweight in proportion to loads being handled.

The PARSONS CRANE

has lowered the cost of maintenance work including

Laying	Rail
	Frogs
	Double Crossings
Placing	Bridge Girders
	Culvert Timbers
	Drain Pipe
Handling	Ties
	Coal
	Ballast
	Scrap
Operating	Electric Tools
	Magnet
	Saws
	Drills
	Bolt Wrenches
Operating	Pneumatic Tools
	Tampers
	Drills
	Hammers
	Riveters

Investigate. First of all, write for names of other railroad men who are using Parson Cranes. Get the facts first-hand.

Manufactured by The Parsons Company, Newton, Iowa

Sales Representatives Fairmont Railway Motors, Inc., Fairmont, Minn.

District Sales Offices

New York, Washington, D. C. — Chicago — St. Louis, New Orleans — San Francisco, Winnipeg, Canada

BALDWIN LOCOMOTIVE WORKS, Foreign Representatives

—and a closed face!

There are only two units to Federal Concrete Cribbing. This obviously means a big saving in cost of installation. And the Y-shaped ends of the anchor members form a cellular wall of great strength which holds the backfill without the use of a third member in the bank.

Federal construction produces a closed face wall with all the fine appearance of good masonry. There are no wide openings between face members for backfilled material to filter through. A one inch continuous slot is allowed for drainage. There are no other openings in the face of the wall.

Federal Cribbing can be erected by ordinary labor in any weather—and standard units can be used on curves up to 20 degrees. Where re-location is necessary, there is practically 100 per cent salvage.

Write for information and photographs of installation for some of America's leading railroad systems.

FEDERAL CEMENT TILE COMPANY
608 S. Dearborn Street, Chicago

FEDERAL CONCRETE CRIBBING

BUDA
ESTABLISHED 1881

BUDA STEEL WHEELS

Punched Web Type

Buda Rolled Wheels
DOUBLE TREAD

Solid Web or Disc Type

Specify Buda Steel Wheels
for Railroad Motor Cars, Hand and Push Cars and Velocipede Cars

Made from Single Plate Special Open Hearth Flange Steel

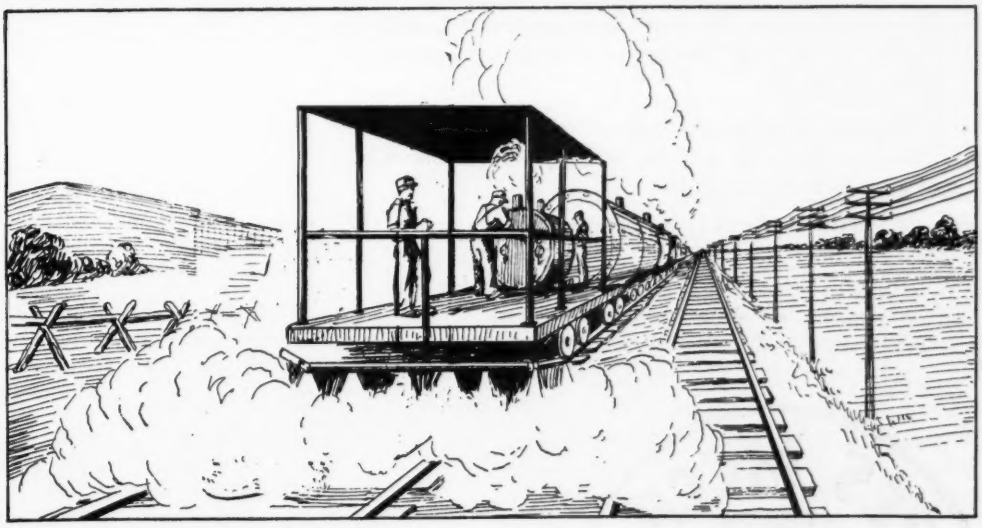
Greatest Resistance to Wheel Load

LIGHT
STRONG
DURABLE

HARVEY PRESSED WHEELS

The Largest Manufacturer of the Most Complete Line of Railroad Materials and Track Supplies

THE BUDA COMPANY
HARVEY (CHICAGO SUBURB) ILLINOIS
NEW YORK, CHICAGO, ST LOUIS, ATLANTA, SAN FRANCISCO, LONDON



A Sledge-Hammer to Crack a Peanut?

Using an expensive work-train and large crew for weeding tracks is necessary only for heavy traffic, high-revenue lines. Medium or light traffic lines with dirt, gravel or cinder roadbed can save heavy expense and keep weeding costs in proper proportion to revenue by using the

Woolery Weed Burner

$3.00 to $6.00 Per Mile

Refractory Burner-Hood the Cause of Woolery Success

The ordinary hot plate weed burners should not be confused with the thorough-going Woolery outfit. The Woolery patented refractory hood, lined with re-placeable fire-brick like the baffle in a locomotive firebox, is the secret of Woolery thorough weed destruction and fuel economy.

During burning operations the Woolery Burner-Hood is filled solid full of swirling flames that curl out from under the edges of the hood killing all vegetation. You never see streaks of unburned weeds left behind a Woolery Weed Burner—neither do you find wasted fuel oil, for the Woolery Ventura tube and refractory hood achieve complete fuel combustion.

Lowest Cost Per Mile

The Woolery Weed Burner destroys weeds at the lowest cost per mile, including first cost of equipment, payroll expense, fuel, power, repairs and upkeep.

Railway executives need no longer neglect low revenue roadbeds and allow weeds to work havoc with ballast, ties and tractive power. Nor is it any longer necessary to expend huge sums of money in weeding by hand labor or by expensive work-train outfits.

Large Enough for Thorough Work Small Enough to Be Easily Handled

Work-train methods of fighting weeds are like using a sledge hammer to crack a peanut. First cost, maintenance and payroll are all too great.

The Woolery 3-Unit Motor Car Weed Burner is small enough to be economical, has speed enough (20 miles per hour) to be run to a siding when necessary, yet is large enough to do a thorough job of weed destroying.

Get the Woolery Weed Burner Data Book

We have prepared an interesting and informative booklet on the Woolery Weed Burner. You should have this data book available for quick reference.

Ask Us to Demonstrate the Woolery Weed Burner

TEAR OFF THIS MEMO COUPON NOW

MEMO

Write the Woolery Machine Co., Minneapolis, Minn., to mail me free a copy of their Descriptive Book on the Woolery Weed Burner.

Woolery Machine Co.

2913 Como Ave. S. E. Minneapolis, Minn.

BUYING properly seasoned and carefully treated cross ties is real economy—a safeguard against decay. Further protecting this costly investment with Lundie Tie Plates is maximum economy—a safeguard against mechanical abrasion.

Mechanical wear is more destructive than decay. Lundie Tie Plates, by their scientific design, prevent the cutting of a single fibre of the tie—

THERE IS NO SUBSTITUTE FOR LUNDIE

The Lundie Engineering Corporation
285 Madison Avenue, New York
166 West Jackson Boulevard, Chicago

LUNDIE
TIE PLATE

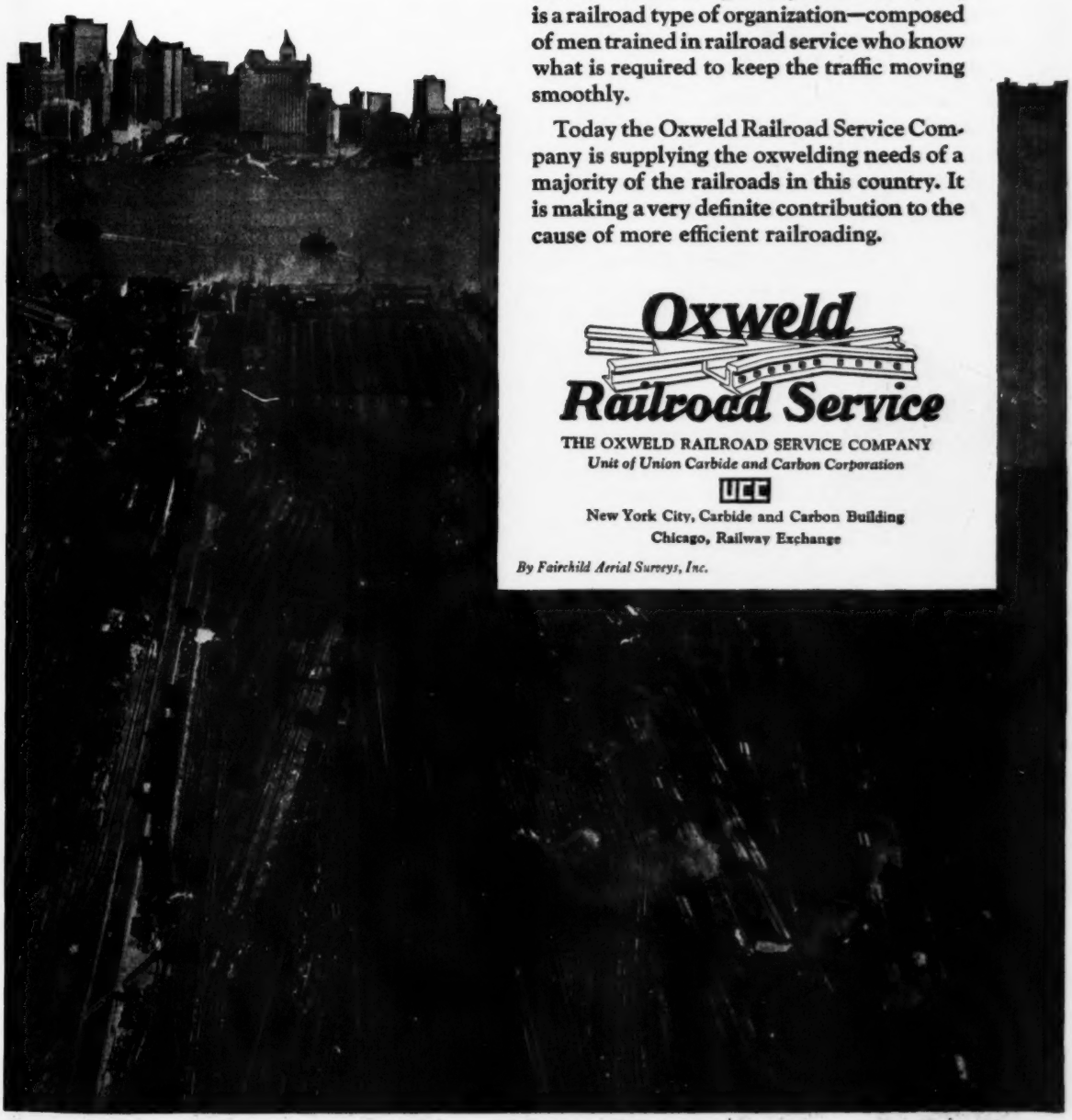
THE WHEELS OF RAILROADING

THE railroad terminal. An inspiring sight! Trains pouring forth hundreds of hurrying travellers. Freight cars being loaded, shifted and unloaded. Powerful engines—ceaseless activity.

Yet beneath this seeming confusion is the guiding hand of a great organization. An organization that controls every movement on every part of the system. A human organization responding to the demand for better and better transportation.

The Oxweld Railroad Service Company dovetails into this great system. For it, too, is a railroad type of organization—composed of men trained in railroad service who know what is required to keep the traffic moving smoothly.

Today the Oxweld Railroad Service Company is supplying the oxwelding needs of a majority of the railroads in this country. It is making a very definite contribution to the cause of more efficient railroading.

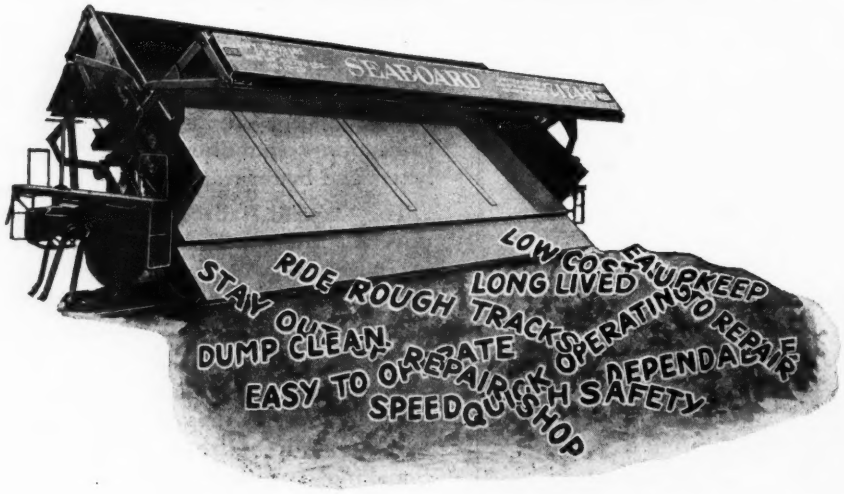


By Fairchild Aerial Surveys, Inc.

Oxweld Railroad Service

THE OXWELD RAILROAD SERVICE COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
New York City, Carbide and Carbon Building
Chicago, Railway Exchange

SPILLING THE FACTS



Every time you dump a Western out come the Facts. Western Automatic Air Dump Cars equipped with aprons for railroad use tell their own time and labor saving story.

They dump fast and clean.

They throw the load beyond the ballast.

They can be righted where they stand without shoveling or moving up.

They dump by air to either side instantly without preparation or change of mechanism.

Western Air Dump Cars operate with a low air pressure and the total air consumption is comparatively small, which saves both time and expense.

Their strength keeps them out of the repair shop.

WESTERN WHEELED SCRAPER CO.

Pioneer Builders of Dump Cars

AURORA, ILLINOIS, U. S. A.

Western

Sheffield 44

It stands above its class

No other one-cylinder water-cooled section car offers the advanced features of the sturdy, powerful Sheffield "44." The old notion that an uncertain belt drive was a necessary evil in this type of car has been exploded by the development of a positive chain drive operated by a clutch that the roughest treatment can't faze.

The single advantage of belt drive—the ability to slip the belt when starting or maneuvering—is possessed in still greater degree by the smoothly operating clutch of the Sheffield "44." And the many drawbacks of belt drive—the delays for belt repairs and the power-wasting slipping on grades or in rainy weather—are eliminated by its positive chain and sprocket drive.

This perfected drive is merely characteristic of other advanced features such as full accessibility, improved fuel-saving two-cycle engine, and the pressed steel auto-type frame described opposite.

Investigate other cars in its price class, but be sure to also examine the Sheffield "44." You will then know that its value is duplicated in no other moderately priced car.

Sheffield "44" with body removed to show auto-type frame construction and advanced type of engine and driving mechanism.

Auto-type pressed steel frame

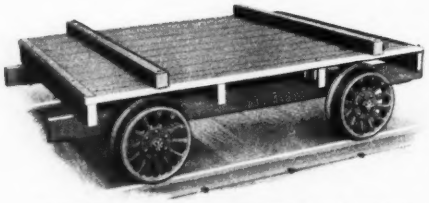
—another Fairbanks-Morse refinement

Pressed steel frames provide maximum strength with minimum weight. They assure rigid and precise alignment under severe conditions, and possess an ideal springiness that assures returning to correct alignment when deflected by violent stresses. They will stand shocks without injury that would ruin a wood frame—they will not warp, shrink or swell, due to climatic conditions. Of no other type of frame construction can so much be said.

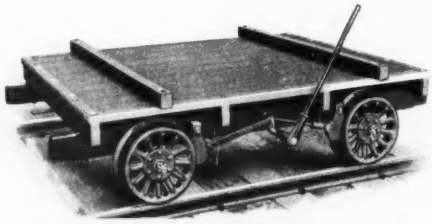
FAIRBANKS-MORSE
MOTOR CARS

First on the rails — and still first

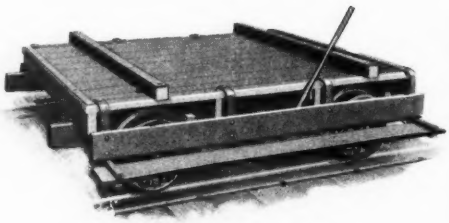
New standards for trailers *and* push cars



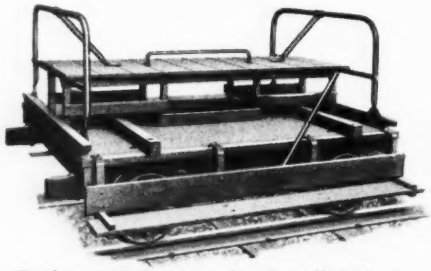
Stripped push car. Dump box sills on deck facilitate unloading frogs, rails, ties, etc., and transmit load forces directly to bearings without strains on frames.



Trailer equipped with sturdy, powerful four-wheel brakes and safety coupler.



Trailer with side steps and brakes.



Trailer completely equipped with rigidly built, removable seat top section, side steps and brakes.

Here is construction that puts the push car or trailer on an entirely new plane. It is construction that incorporates features ordinarily considered too good for this type of car, yet performance is proving that the higher standards are more than justified.

For the first time Timken Tapered Roller Bearings are found on push cars and trailers. Other evidences of advanced design are improved adjustable toggle brakes with greatly increased braking power and the use of two bronze-bushed loose wheels to facilitate handling.

The double Timken bearings are mounted in dust-proof boxes and are conveniently oiled through holes in the deck which communicate with oil tubes reaching to the axle boxes. The superiority of Timken bearings for handling a combination of thrust and radial loads has been well demonstrated throughout the automotive field and is plainly an outstanding advantage in cars of this type.

Wheels are the well known 16-inch Sheffield pressed steel type with ground treads—the type that is used on Sheffield Motor Cars. Frames are of carefully selected, hard maple, and the sills are gained into each other and securely bolted.

As a result of the many improvements the capacities of these push cars and trailers have been increased to 6,000 pounds for the "4-B," and 10,000 pounds for the "12-B," with the same liberal factor of safety that formerly applied to 4,000 and 8,000 pound ratings.

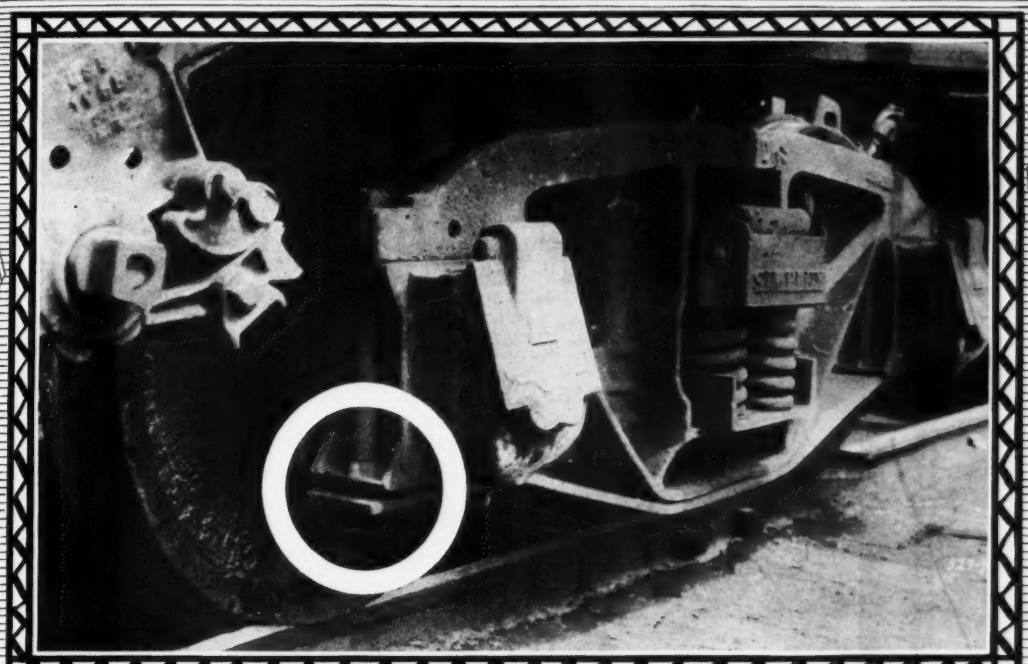
Cars are supplied with the different equipments illustrated here and are fully described in a new F-M Bulletin. Write for it.

FAIRBANKS, MORSE & CO., Chicago

FAIRBANKS-MORSE

PUSH CARS *and* TRAILERS

ARA21.25



You never see Journal Box Bolts like these where SELFLOCK UNIT NUTS "PATENTED" are used!

VIBRATION exacts an enormous toll in lost bolts and nuts of which the above illustration is a typical example.

Selflock Unit Nuts were designed to meet a long felt want for a positive locking unit nut that would remain permanently tight regardless of the most violent vibration.

Selflock Nuts were developed by years of critical experimentation, tested by the most severe laboratory tryouts and today are proved in actual railroad service to be the most successful unit nut ever introduced in the railroad industry.

"They lock on every thread"

"The Nut with the Star Crown"

GRAHAM BOLT & NUT COMPANY
Pittsburgh · Established 1874

Graham Bolt and Nut Company, Pittsburgh.

Announcing

the Opening of the New

Illinois *Alloy* Steel Mill

—fitted with the most modern equipment engineering science has yet devised;

—equipped in every detail to carry out with unerring exactitude, the specifications of your engineers;

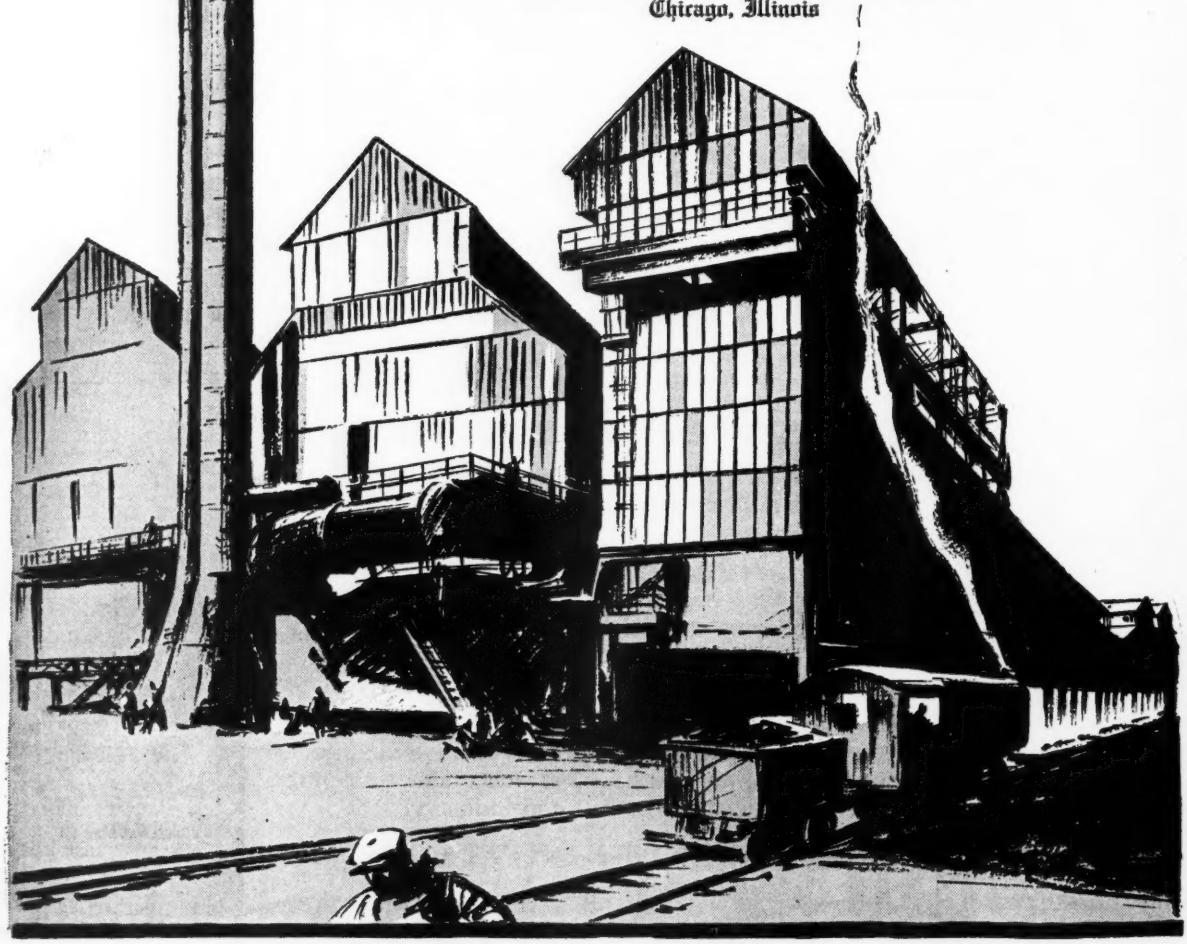
—guided by a personnel of carefully selected, technically trained and thoroly seasoned alloy specialists;

—designed thruout with one object in view—close-gauge rolling on steel that meets, chemically and physically, your specifications.

—Here is a source of supply well worth investigating. We are at your service.

Illinois Steel Company

General Offices: 208 South La Salle Street
Chicago, Illinois



ILLINOIS *alloy* STEEL

More work and less effort with OLIVER AMES shovels

7 *Reasons For Using OLIVER AMES Shovels*

1. The OLIVER AMES Bend—the perfect shovel balance; often copied, never duplicated.
2. Blade of heat-treated alloy steel with maximum resistance to wear.
3. Finest craftsmanship, as details of finish readily prove.
4. Lightest weight construction consistent with strength.
5. Best handle known, genuine Northern Ash, second growth.
6. All Dee-Handles, supplied in OLIVER AMES Split Dee, I-D-L, Sturd-E, Wright Metal or Wooden Dee.
7. Distributed by best dealers throughout the world.

Cinders, sand, ballast and gravel are all the same to O. AMES Shovels. They will handle any or all of them day after day and stand up under it.

There is less effort required with an O. AMES Shovel. The famous O. AMES Bend in the handle makes it easier for the operator to get a real shovelful more times per hour.

The first cost is low, but you get the real saving in their long life. Specially treated alloy steel and selected Northern Ash make a long-wearing combination.

Write for catalog showing all sizes and types.

O. AMES SHOVELS

SHOVELS-SPADES-SCOOPS

At good supply houses everywhere

AMES SHOVEL AND TOOL CO. - - - Ames Bldg., Boston
Owners of Oliver Ames & Sons Corp., North Easton, Mass. Est. 1774

1063

SAVE 60% OF LABOR AND TOOL COSTS

WHAT ALL MAINTE-NANCE OFFICIALS WANT

TRY THEM ON TOUGH JOBS— THEY ALWAYS MAKE GOOD

Showing 3 Men Lining Track with 3 Hackmann Combination Track Liners
Saving Labor Cost of 4 or 5 Men
7 Men Can Do the Work of 15 or 20 Men

EFFICIENCY WITH ECONOMY

Now in use on over 100 railroads.

Results always far above expectations.

Labor costs cut in half.

Small and easy to handle. Weight only 20 lbs. Made of steel.

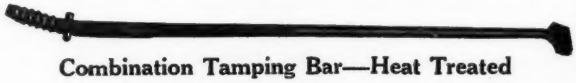
Lines track, frogs and switches.

Raises low joints and spaces ties.

Smooths rough track without disturbing road bed. Can be operated against the end of switch ties.

HACKMANN TRACK LINERS HAVE ALL THE ABOVE STERLING QUALITIES

Combination Lining Bar—Heat Treated



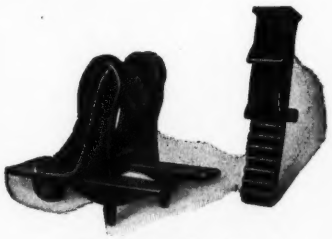
Combination Tamping Bar—Heat Treated

Hackmann Combination Track Liner

Hackmann Combination Track Liners are operated with the above special bar.

Hackmann Duplex Track Liners are operated with ordinary lining bar. Removable Fulcrum.

Note the Two Step Feature at top of base. You can make at least two pulls without resetting the liner. They can be left in track, allowing trains to pass over without any danger.



Hackmann Duplex Track Liner

WRITE FOR ILLUSTRATED AND DESCRIPTIVE LITERATURE

THE HACKMANN RAILWAY SUPPLY CO.

J. J. FRANZEN, *Secretary and Treasurer*

RAILWAY LABOR SAVING DEVICES—723 S. WELLS ST., CHICAGO

THOMAS D. CROWLEY CO.
Representatives
Chicago, Ill.

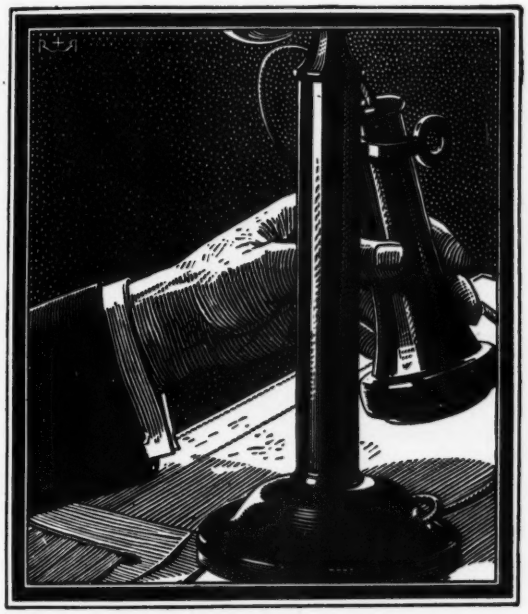
BALDWIN LOCOMOTIVE WORKS
Foreign Representatives
Philadelphia, Pa.

WM. ZEIGLER & CO.
425 S. Fifth Street
Minneapolis, Minn.

THE HOLDEN CO., Ltd., Canada
Montreal Toronto Winnipeg
Vancouver

ADDRESS ALL COMMUNICATIONS TO THE COMPANY

Bought 500,000 *feet of lumber* . . . 1000 miles away



A MEMPHIS LUMBER firm's representative called at the office of a buyer a thousand miles away. He found him in the market for a half-million feet of lumber. He wired this news to his company. They called him at once by long distance telephone, catching him before he left the prospective buyer's office. . . When the receivers were hung up, the deal had been closed.

MANY OTHER LUMBER COMPANIES have like experiences. For example, Atlanta: " . . . Looking over a list of our stock yesterday, saw an item we thought one of our customers might want. Decided to call by Long Distance. Expense, possibly $3.50. Developed an order for 5 cars of lumber."

From Nashville: " . . . Last week we secured a 5-car order by telephone from one of our Louisville customers . . . this week 3 cars to a Knoxville connection." Jackson, Mississippi: " . . . A few weeks ago we sold a quarter-million feet of lumber over the telephone to Toronto, Canada." Mobile: " . . . We do over 80% of our lumber buying over the long distance phone." Memphis: " . . . For quick action, for learning the last-minute status on any out-of-town situation, and in effecting satisfactory adjustments, nothing we know of will take the place of long distance service."

For good results, quick, try long distance calls. They'll usually cost less than you think. . . . . *Number, please?*

BELL LONG DISTANCE SERVICE

Replace the Trestle with a Toncan Culvert

WHY put up with a trestle and its accompanying maintenance and dangers when a Toncan Iron Culvert will furnish the needed drainage?

The illustration shows such a replacement in progress on the line of a prominent road. The Toncan Culvert being laid will provide ample draining capacity, while Toncan construction assures the requisite strength—fill or operating loads cannot buckle or bend it.

A continual maintenance job—the trestle—is literally being buried; operating safety is improved, while a long-lasting, corrosion-resisting Culvert is assured because of Toncan Iron's copper and molybdenum content.

Give a thought to the replacement of trestles by Toncan Iron Culverts where it is possible to do so.

CENTRAL ALLOY STEEL CORPORATION, *Massillon, Ohio*
World's Largest and Most Highly Specialized Alloy Steel Producers
Makers of Agathon Alloy Steels
Cleveland Detroit Chicago New York St. Louis
Syracuse Philadelphia Los Angeles Tulsa
Cincinnati San Francisco Seattle

TONCAN COPPER Mo-lyb-den-um IRON

Following are the makers of Toncan Culverts. Write the nearest one:

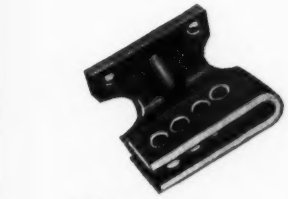
The Berger Manufacturing Co. Roanoke, Virginia
Tri-State Culvert Mfg. Co. Memphis, Tenn.
The Canton Culvert & Silo Co. Canton, Ohio
The Firman L. Carswell Mfg. Co. Kansas City, Kan.
The Berger Manufacturing Co. Minneapolis, Minn.
The Berger Mfg. Co., of Mass. Boston, Mass.
The Berger Manufacturing Co. Philadelphia, Pa.
The Berger Manufacturing Co. Dallas, Texas
The Berger Manufacturing Co. Jacksonville, Florida
The Pedlar People Limited. Oshawa, Ontario, Canada
Wheat Culvert Co., Inc. Newport, Ky.

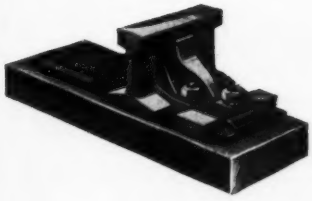
On the line of a well-known road, this Toncan Culvert, 5 ft. in diameter and 160 ft. long, is replacing a trestle, which is being buried in the fill.

TONCAN COPPER MO-LYB-DEN-UM IRON

THE ECONOMY OF WISE SELECTION

IN TRACK SPECIALTIES

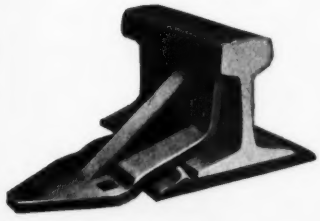




A wise selection is the truest form of economy. Lasting qualities, far more than the initial cost, are what determine true expense.

Tested values—proven performance, long life and durability—these are what you purchase in RACOR track specialties. They are truly the important factors in ultimate economy yet even with respect to first price, weight of material and quality considered, RACOR PRODUCTS cost no more.

RACOR PRODUCTS meet the problem of economy in all ways. Long life, low initial cost, small maintenance expense, definitely make them your wisest selection.



MAIN OFFICE-HILLBURN, NEW YORK

Sales Offices at
30 CHURCH ST. New York
and at

RAMAPO-AJAX-ELLIOT WORKS

Hillburn, New York
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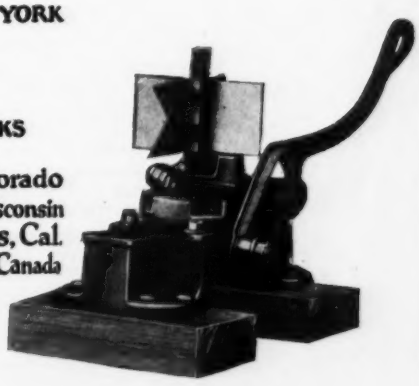
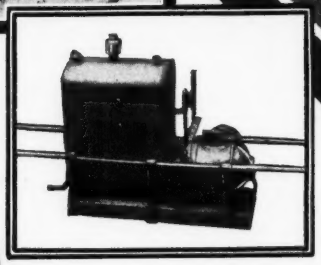
Pueblo, Colorado
Superior, Wisconsin
Los Angeles, Cal.
Niagara Falls, Canada



RACOR
TRADE MARK

RAMAPO AJAX CORPORATION



2 men instead of 6

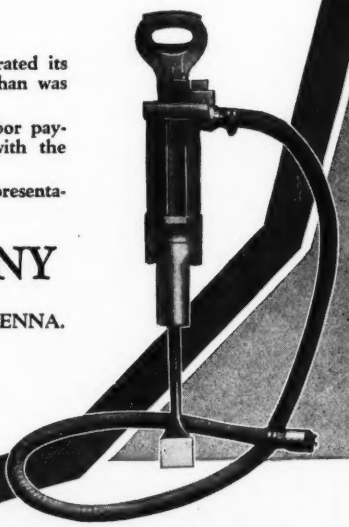
The Syntron Tamper power unit is so designed as to be adaptable for operating rail drills, wrenches, hand drills, wood augurs, grinders, mills, rail saws, electric compressors for sand blast and paint-spraying, flood-light systems and all other electric devices essential to maintenance work.

The remarkable efficiency of the Syntron Tie Tamper striking 1500 blows per minute, its unique magnetic principle of operation requiring only one moving part,—the piston,—and the light, portable power unit all combine to make the Syntron the most practical, economical tie tamper ever introduced to the railroad industry.

The Syntron is tried, tested and perfected. It has demonstrated its ability to tamp a far better track quicker and with less men than was ever possible by pick tamping.

Railroads are now realizing the enormous savings in their labor payroll that can be effected by standardizing track equipment with the Syntron Tie Tampers and Power Units.

Why not get acquainted with the Syntron by having our representative demonstrate its many unique advantages.



THE SYNTRON COMPANY

Lexington Avenue

PITTSBURGH PENNA.

SYNTRON

Electric Tie Tampers

DEPENDABLE-

Day After Day

The builders of Kalamazoo Motor Cars are more than willing that the dependability and endurance of these cars should be made subjects for comparison.

Day after day, year in and year out, Kalamazoo Motor Cars in practically every civilized country in the world have returned a full measure of what their owner paid for—**service.**

For their strength and endurance Kalamazoo Motor Cars are light—but they are built for strength and endurance. Lightness is secondary.

Kalamazoo Means Service to You

KALAMAZOO RAILWAY SUPPLY CO.

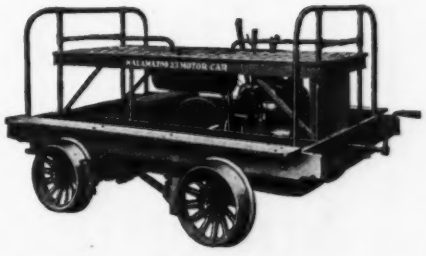
Established 1884

Kalamazoo **MICHIGAN**

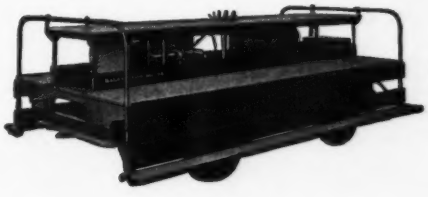
New York	New Orleans	Portland, Ore.	Johannesburg
Chicago	Denver	Havana	Vancouver
St. Louis	Spokane	London	Winnipeg
St. Paul	Seattle	Mexico City	Montreal

Kalamazoo "17," seating capacity, 6 to 8 men.

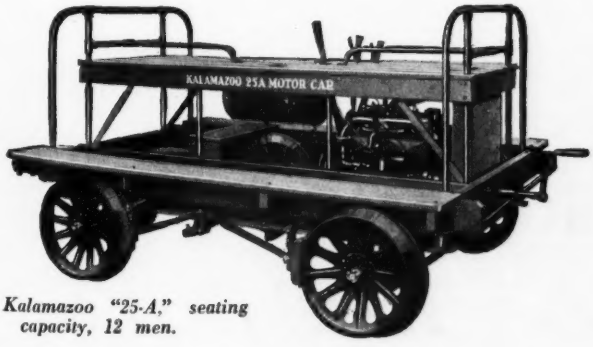
Kalamazoo "16-L," seating capacity, 2 men.



Kalamazoo "23," seating capacity, 8 to 10 men.

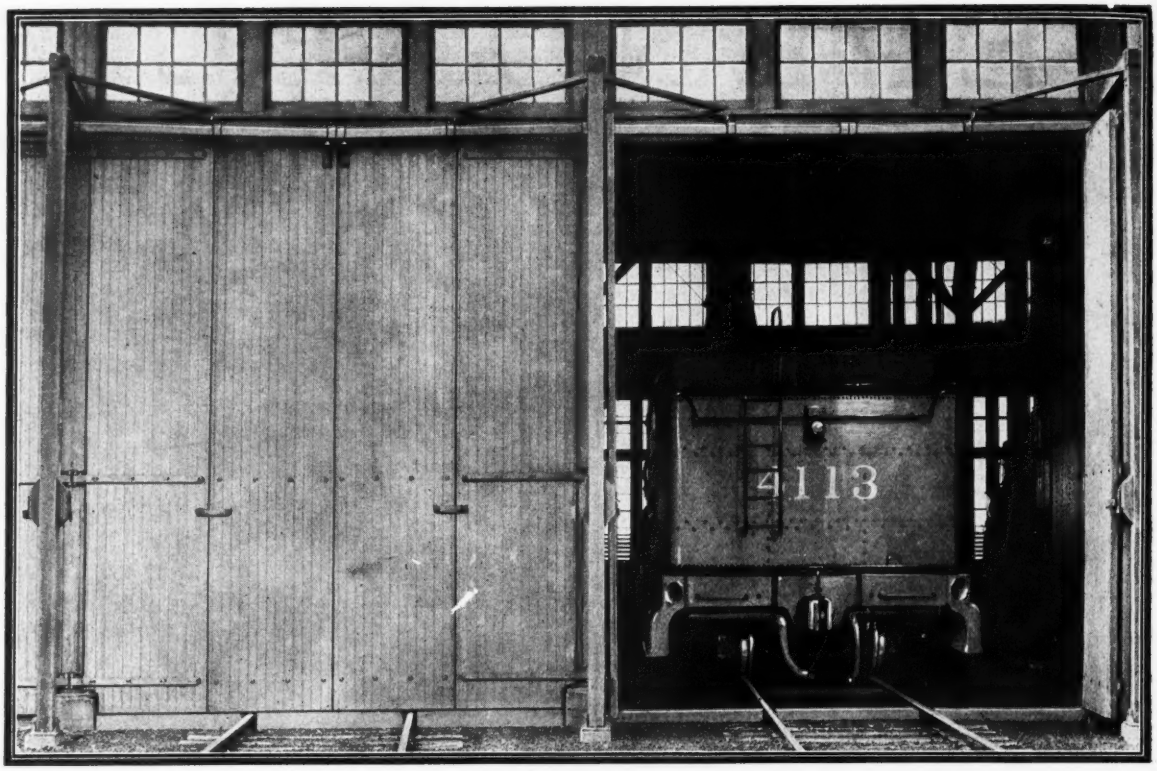


Kalamazoo "35," seating capacity, 30 men.



Kalamazoo "25-A," seating capacity, 12 men.

Kalamazoo "25-A Hump Car," seating capacity, 24 men.



On the windy plains of *Oklahoma*

Slidetite solves Frisco doorway problems

THE FRISCO line had an acute doorway problem at their Oklahoma shops. Doors of locomotive size, open country, high winds, storms—these combined to make frequent and serious trouble.

Then they installed doors equipped with *Slidetite* industrial door hardware. Their troubles disappeared.

Slidetite industrial equipment is the most logical equipment for large doorways. Doors so equipped operate easily and surely, stay where they are put, close smoothly, surely, weathertight. When open the doorway is clear from jamb to jamb—no obstructions. It is the most practical hardware for any doorway up to 30 feet wide.

Slidetite industrial door hardware is sensible economy.

Richards-Wilcox Mfg. Co.

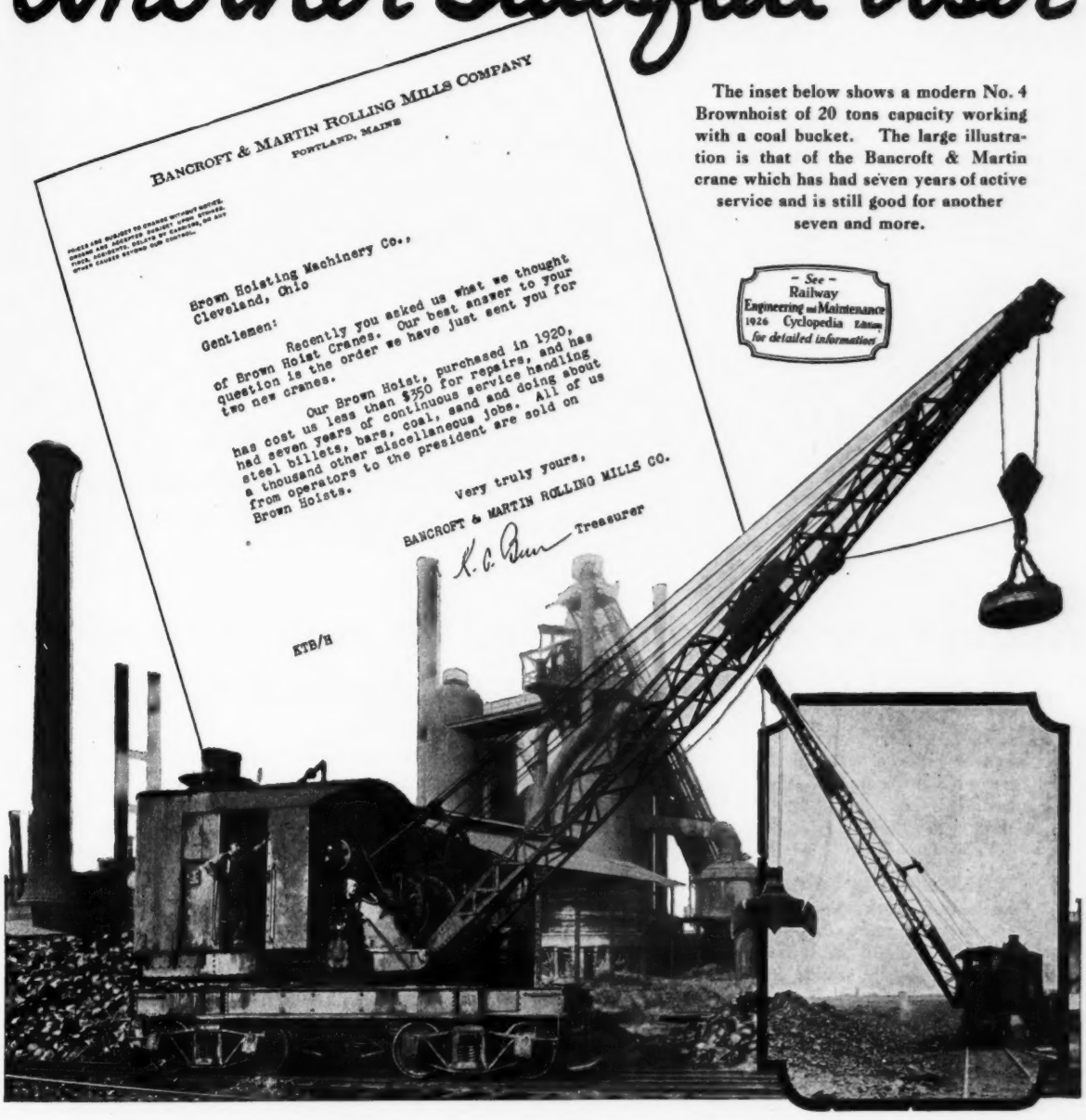
"A Hanger for any Door that Slides"

AURORA, ILLINOIS, U.S.A.

New York Boston Philadelphia Cleveland Cincinnati Indianapolis St. Louis New Orleans Chicago Minneapolis Kansas City Los Angeles San Francisco Omaha Seattle Detroit.

Montreal · RICHARDS-WILCOX CANADIAN CO., LTD., LONDON, ONT. · Winnipeg

Another Satisfied User


BANCROFT & MARTIN ROLLING MILLS COMPANY
PORTLAND, MAINE
Brown Hoisting Machinery Co.,
Cleveland, Ohio
Gentlemen:
Recently you asked us what we thought of Brown Hoist Cranes. Our best answer to your question is the order we have just sent you for two new cranes.
Our Brown Hoist, purchased in 1920, has cost us less than $350 for repairs, and has had seven years of continuous service handling steel billets, bars, coal, sand and doing about a thousand other miscellaneous jobs. All of us from operators to the president are sold on Brown Hoists.
Very truly yours,
BANCROFT & MARTIN ROLLING MILLS CO.
Treasurer
KTB/H

The inset below shows a modern No. 4 Brownhoist of 20 tons capacity working with a coal bucket. The large illustration is that of the Bancroft & Martin crane which has had seven years of active service and is still good for another seven and more.

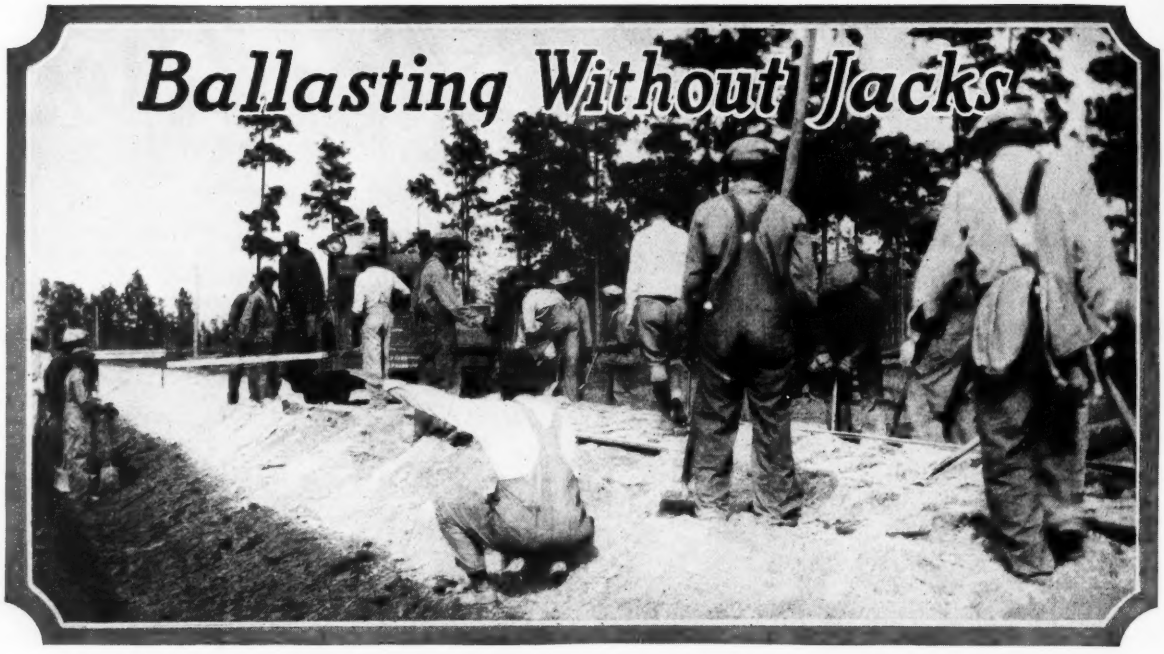
– See –
Railway Engineering and Maintenance 1926 Cyclopedia Edition for detailed information

The Brown Hoisting Machinery Co., *Cleveland, Ohio*

Branch Offices: New York, Chicago, Pittsburgh, New Orleans, San Francisco, St. Louis.

BROWNHOIST

GOOD MATERIAL HANDLING EQUIPMENT



The Track Machine is being used for ballasting a 150 mile railroad job in the South. Equipped with boom and hoist, it was also used for the re-laying of steel.

Reduce the cost and speed up your operations when shifting, raising and ballasting track

For six successive working days, this track gang with the aid of the Track Machine, ballasted on an average of 6,000 feet of track per day. The best day's work was 7,700 feet in 8¾ hours of actual working time.

The Nordberg Track Machine, when used for ballasting work, dispenses with track jacks and permits the men ordinarily used for the jack crew to be put to more profitable work. In addition to the saving in labor which the machine effects, it also permits of much greater speed than can be secured with jacks.

It is especially efficient in mud or soft material where it is difficult to work with hand tools. With a powerful lifting force of 50,000 pounds, it will lift the track up through the ballast that is spread over the ties from center dump cars. If you have a ballasting job to do, investigate the possibilities of the Track Machine.

By equipping it with boom and hoist, it is equally suitable for re-laying steel. The Track Machine is an all-purpose machine that will pay a big return on the investment.

Write Track Machine Department for Bulletin YE-8

NORDBERG MFG. COMPANY **Milwaukee, Wis.**

THE NORDBERG PATENTED TRACK MACHINE

Dependable
Mechanical Painting Equipment

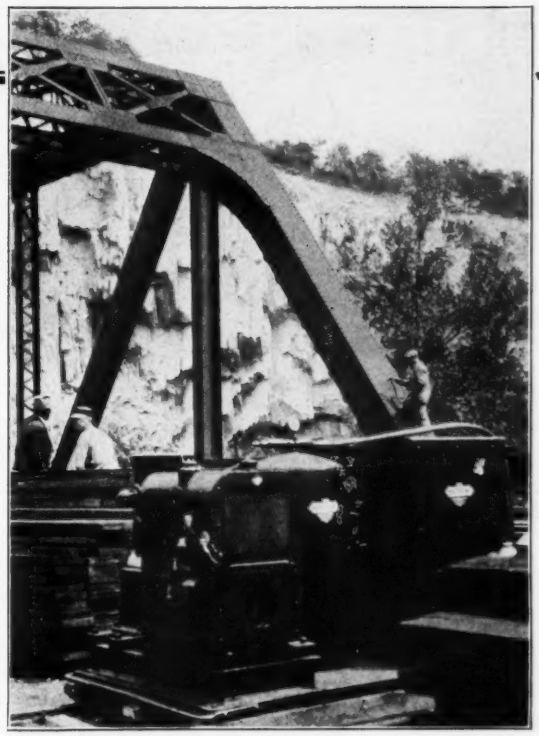


Illustration at right shows a Figure 105 Matthews Mechanical Painting Equipment being used for painting a railroad bridge.

No longer is it a question of whether Mechanical Equipment will effect a definite, worth while saving in the cost of railroad maintenance painting. Experience has proven conclusively its economy. Now it is only a question of the dependability of the equipment itself.

The fact that an increasing number of railroads are installing Matthews Mechanical Painting Equipment and adding to what they already have in service, certainly indicates the ability of the Matthews Equipment to stand up under this service and perform satisfactorily.

Take the case of the Baltimore Division of the B. & O. After testing a number of makes, this railroad standardized on the Matthews Figure 105 illustrated below and equipped each of their thirteen division points with Matthews Equipment.

Let us show you how a Figure 105 Matthews Mechanical Painting Equipment is especially adapted to your maintenance painting work.

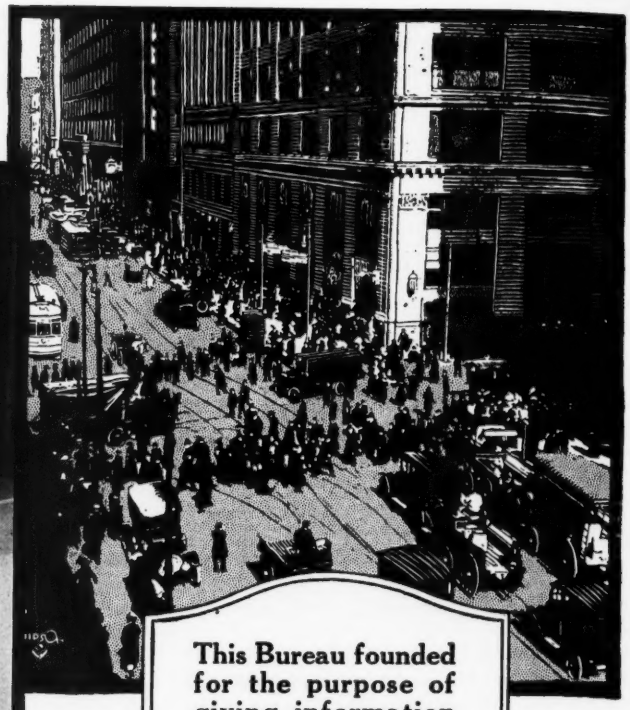
Fig. 105. Complete two-unit with heavy duty equipment. Air capacity sufficient to operate three units or one rotary wire brush.

Get This Booklet

"Mechanical Painting For Maintenance" is a 12-page booklet that will answer many of the questions you will want to ask about your painting problems. Tells about mechanical painting in general. Gives comparative costs on brick, corrugated iron, stucco, weatherboard, shingle roofs, tanks and all kinds of materials handled and how to select them. Shows photographs of different equipments and close ups of various units in their make up. Gives extracts from 14 letters received from prominent manufacturers regarding their experiences. Has a page of questions and answers. Tells about instruction to your men and service you can expect. Send for this booklet today.

W. N. MATTHEWS CORPORATION
3770 Forest Park Blvd. St. Louis, U. S. A.

MATTHEWS
MECHANICAL PAINTING
EQUIPMENT



A tribute to Chicago's judgment of 75 years ago

This piece of Cast Iron Pipe is cut from a line still in service neath the intersection of two of Chicago's busiest downtown streets. A story of building for permanence.

THIS pipe was removed to make room for the foundation of a new building.

When the outer surface dirt was cleaned off, the pipe was found to be as perfect as the day it was cast.

For inspection purposes a circular piece of the pipe was cut out as shown in the illustration. Even after 75 years, since 1852, there was not the slightest sign of deterioration.

It bears out the oft-repeated statement, "There is no case on record where Cast Iron Pipe has worn out under usual service conditions."

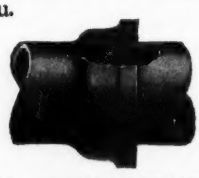
THE CAST IRON PIPE PUBLICITY BUREAU
People's Gas Building, Chicago, Ill.

This Bureau founded for the purpose of giving information and help—*it has nothing to sell.*

Its primary interest is the collection and distribution of all information relative to Cast Iron Pipe for all purposes—and in arousing public interest in water-works construction.

Consulting Engineers, Contractors and Municipal Officials are invited to write.

Of especial importance is an article on the "two mains system." Write to the Research Engineer for a copy of this or other literature on the subject of water systems, which may be interesting to you.



BELL and SPIGOT JOINT—*the accepted standard for underground construction.*

CAST IRON PIPE

—when you want a distribution system to endure

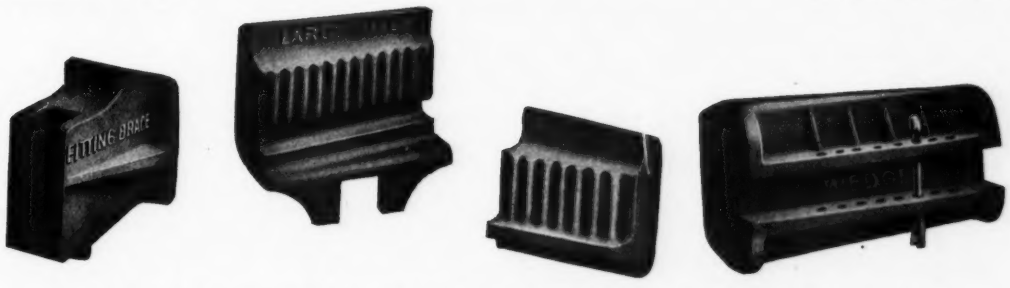
TRASCO

TRADE MARK REGISTERED

GUARD RAIL CLAMP

YOKE--OF STEEL, DROP FORGED. IS INTERCHANGEABLE FOR ALL RAILS UP TO 100 LBS. PER YARD. FOR HEAVIER RAILS WE FURNISH A LARGER YOKE

THOUSANDS IN USE GIVING SATISFACTION

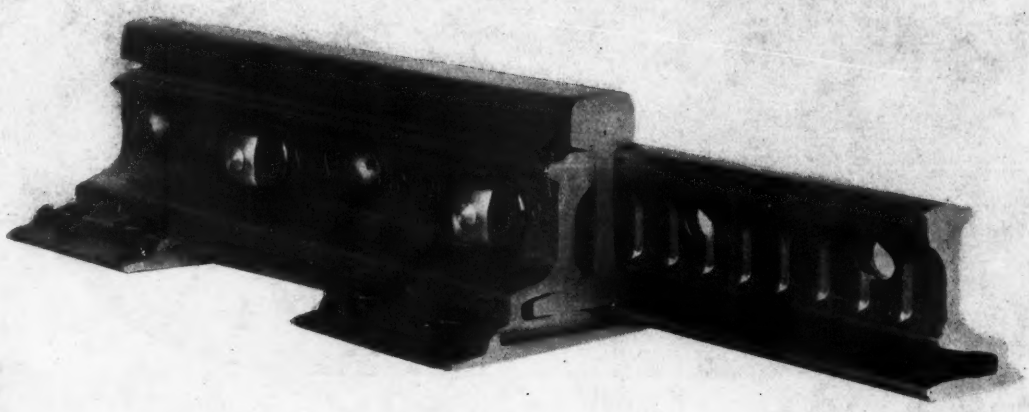


MALLEABLE IRON ADJUSTABLE FILLERS AND WEDGE
CAN BE APPLIED WITHOUT REMOVING GUARD RAIL
WRITE FOR PRICES - YOU WILL FIND THEM ATTRACTIVE

TRACK SPECIALTIES CO.
29 BROADWAY
NEW YORK

KEEPING PACE WITH PROGRESS

Reinforced
HEAD FREE
Continuous
JOINT



THE Head Free fillet bearing area
can never be diminished.

A cocked Head Fishing bar
reduces the head bearing to almost a line.

THE RAIL JOINT COMPANY
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RAIL JOINTS

Digging themselves in

In the many years that Hayward Buckets have served railroads, they have been "digging themselves in"—making themselves firmly established in the confidence of users. Wider and wider usage shows their popularity to be well merited.

Watch a Hayward in action. Note the power with which it digs, the speed with which it picks up an overcapacity load time and time again. See it discharge quickly in an easy flowing stream.

It will pay you to get in touch with Hayward Engineers. They are ready to help you to fit the bucket to the job.

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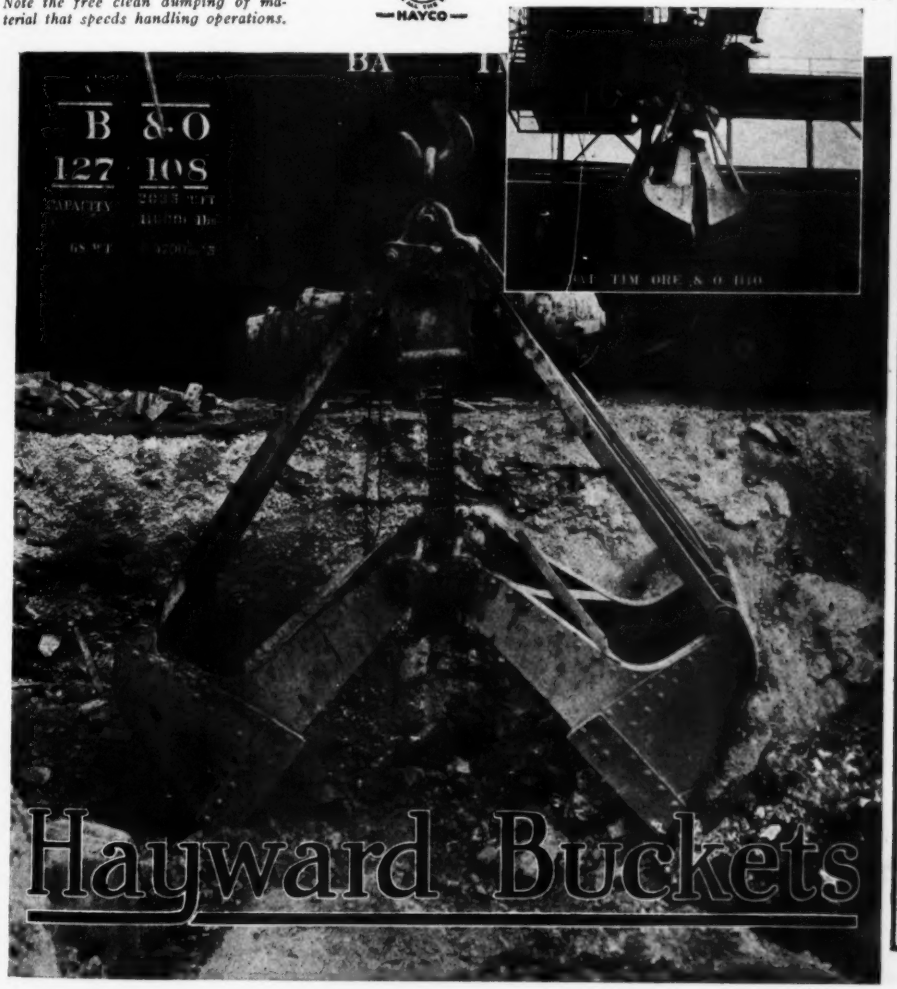
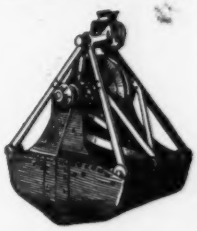
Note the free clean dumping of material that speeds handling operations.



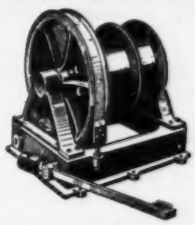
Electric Motor Buckets



Clam Shell Buckets

Orange Peel Buckets

Drag Scraper Buckets



Counterweight Drums

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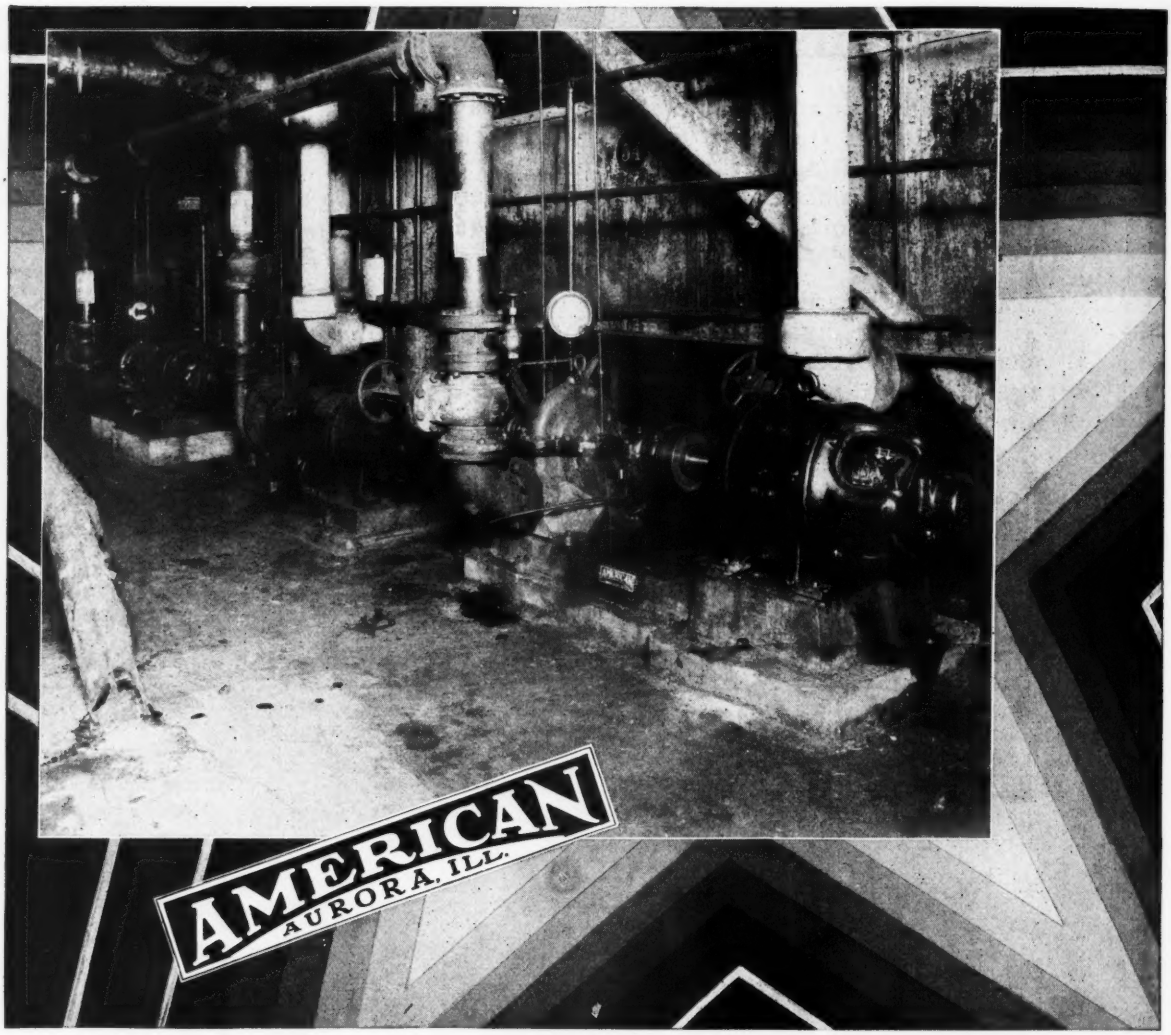

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National Sugar Refining Company Uses "American" Pumps

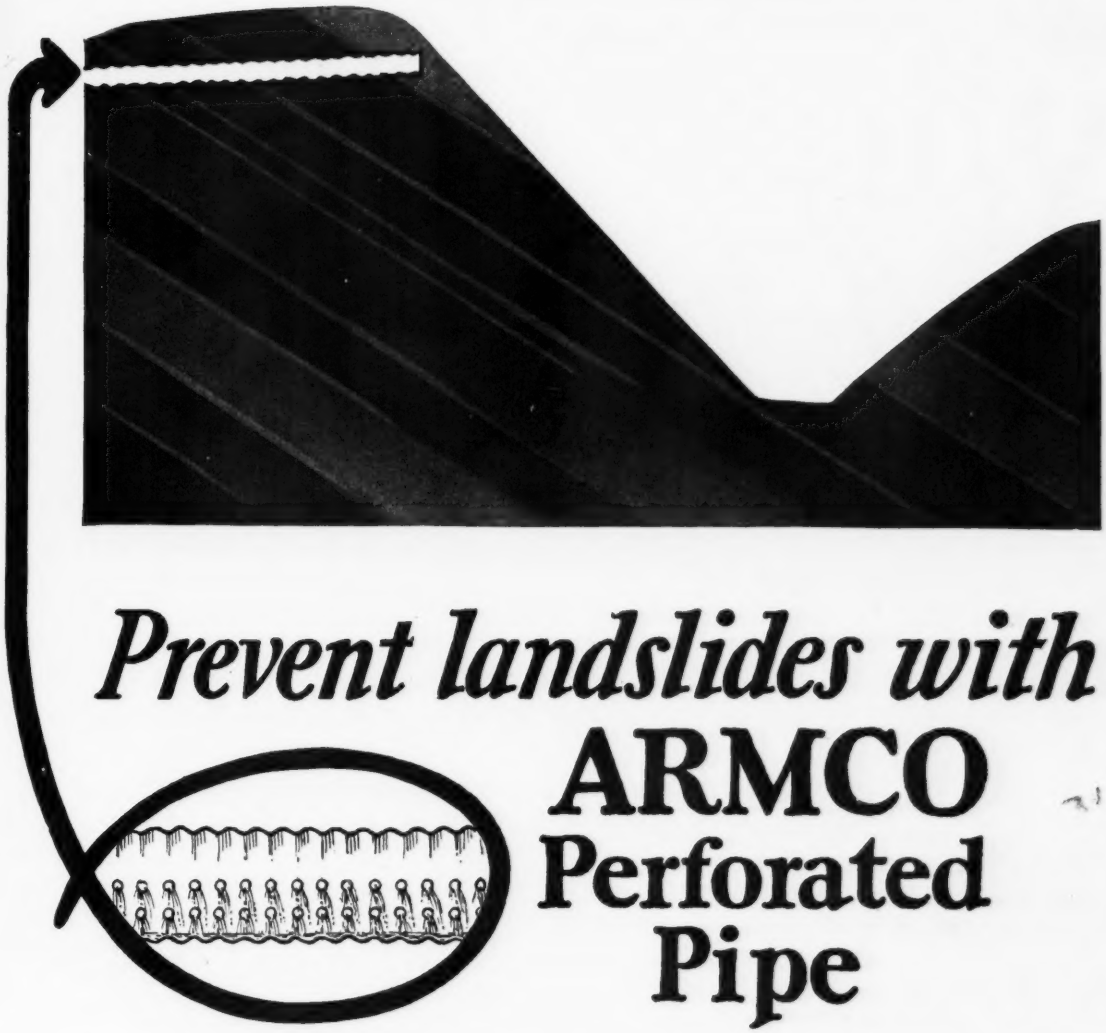
PICTURED above is an installation of American Well Works pumps in one of the plants of the National Sugar Refining Company.

Many of the largest industries of this country use pumps bearing the name-plate of the American Well Works throughout their plants. The efficient handling of liquids in the complicated industrial processes of today demands pumps that are unusually simple in construction, steadfast and powerful in operation. As they are built to the specifications of engineers to meet particular requirements of industrial usage, it is but natural to expect unusual quality and performance from American Well Works pumps.

To aid you in specifying and selecting pumping equipment, the advice of a group of "American" engineers who are thoroughly conversant with industrial practices is at your disposal.

THE AMERICAN WELL WORKS

General Offices AURORA, ILLINOIS *and Factory*



Prevent landslides with ARMCO Perforated Pipe

COSTLY and dangerous landslides can be prevented by protecting your track with properly placed Armco perforated pipe. This protection is especially important in deep cuts and where traffic is heavy.

Armco perforated pipe is particularly adapted to this use because of its strength and its high drainage efficiency. Its flexibility provides immunity to breakage by pressure of soil or impact of traffic. Its firmly connected sections are not easily disjointed by shifting or sliding soil strata. Ample openings admit water freely. Because it is self cleaning it maintains its drainage efficiency.

Preventing landslides is only one of the many practical uses for Armco perforated pipe. In the drainage of open cuts, tunnels, yards and station grounds, multiple tracks and track pans, this pipe is equally advantageous. Our bulletin "Increasing the Efficiency of Roadbed Drainage" describes many of these uses. A post card will bring a copy.

ARMCO CULVERT MFRS.' ASSOCIATION
Middletown, Ohio

ARMCO CULVERTS

Predominant in use—because predominant in quality

© 1927, Armco Culvert Mfrs.' Ass'n, Middletown, Ohio

What Price *International*?

International ties are quality ties. This quality is not accidental. It is put into the ties and it costs money to do so.

International spends thousands of dollars annually to remove immediately all ties from the woods to prevent decay. They are transported to a central yard that is tile drained and kept free from all vegetation. The ties are stacked openly to promote rapid seasoning. They are watched constantly. Moisture samples are taken at regular intervals to prevent over-seasoning and to determine when ties are ready for treatment.

Each tie is inspected singly for decay. Each tie is graded and marked permanently according to A. R. E. A. specifications. Only high grade A. R. E. A. Grade I creosote oil is used for treatment and the full quality of oil stays in the ties.

So you see ***International*** standards are exacting. Manufacturing costs are higher so naturally the price is slightly higher. But you do get ties that last and cost less per year of service.

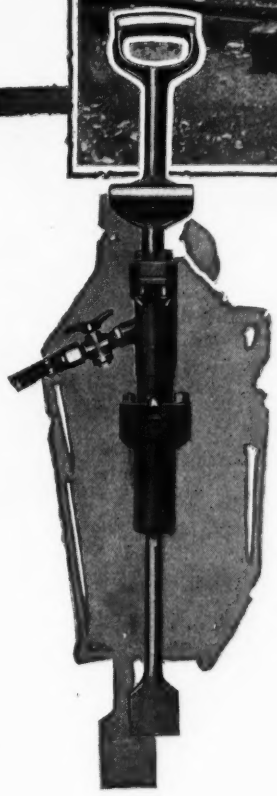
Contract Now for International Ties

International Creosoting & Construction Co.

General Office—Galveston, Texas

2 C 7 The International Dating Nail

The International Pledge Mark of Quality is inserted in each tie



Pneumatic Tamping makes a smoother and longer-lasting roadbed

Ingersoll-Rand Pneumatic Tie Tamping Outfits produce a more uniform quality of work and a safer and easier-riding track than hand tamping. Furthermore, their use results in important savings of both labor and money.

Ingersoll-Rand Company has developed complete pneumatic tamping units in three sizes—4-tool, 8-tool and 12-tool capacities. These units are the result of years of experience in building and servicing pneumatic tamping outfits.

With these complete units there is no division of responsibility—Ingersoll-Rand stands back of the whole outfit. Long experience in the field makes it possible for the Company to offer a superior service and to give complete instructions regarding the organization of gangs and the care and operation of the units.

Ask for complete information and performance statistics on I-R Tie Tamper Units

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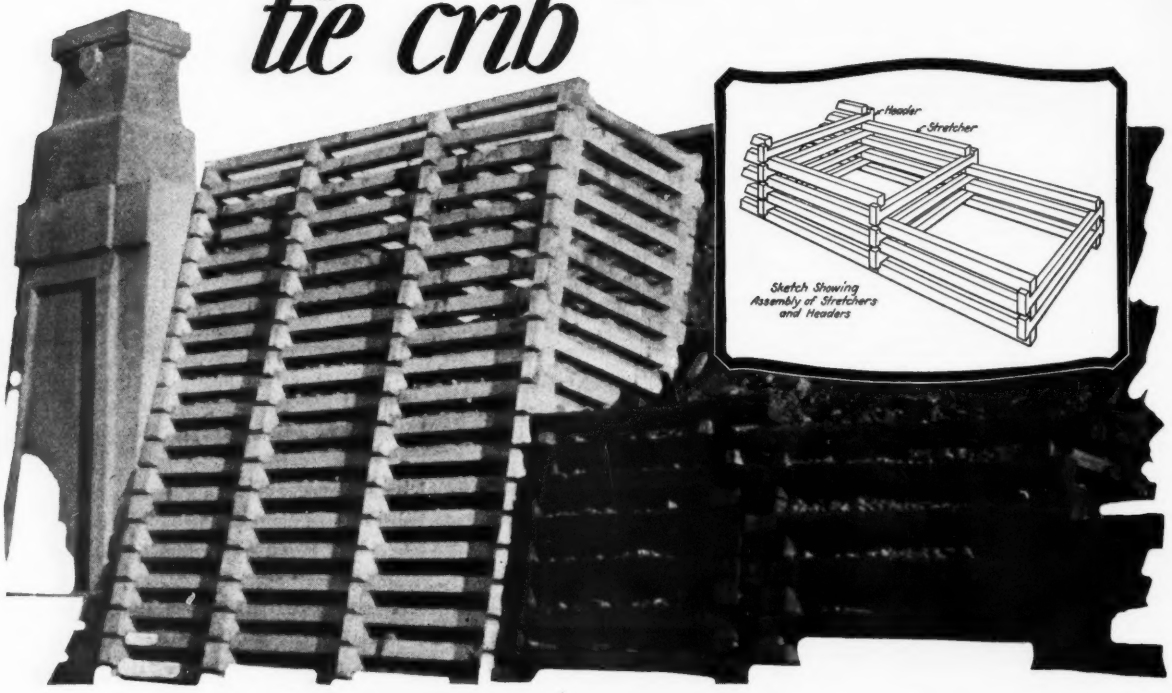
241-TT

Ingersoll-Rand

As easy to lay as an old tie crib



NO one can remember the first time an old tie crib was built to retain an embankment. It's such a simple obvious idea that generation after generation of railway men have used it whenever they needed a temporary retaining wall.

A Massey concrete crib is almost as simple. It substitutes permanent units for the rapidly decaying timber. It provides a proper key to bind the units perfectly together without dowels or rods which may rust and cause discoloration or failure of the wall. It is carefully designed to insure ample bearing on the lower members.

But in its method of construction it is the same simple crib structure laid up in the same way as the old tie crib. It can be built with common labor. No highly specialized mechanics are needed. This means both convenience and economy.

A Massey crib wall is as easy to lay as an old tie crib and as permanent as a monolithic wall. Ask for Catalog Supplement No. 20 showing its many applications.

MASSEY

Concrete Products Corporation, Peoples Gas Building, Chicago

Sales Offices: New York, Atlanta, Cincinnati, St. Louis, Los Angeles

Canadian Concrete Products Co., Ltd., Transportation Building, Montreal, Que.

RE&M 7-Gray

Massey Cribbing is produced in the same plants and is of the same high quality as Massey Culvert Pipe and other precast concrete products which have been standard construction on the leading railroads for years.

Wear-Proof Journals

The 88% reduction in starting load, due to friction elimination, only begins to express the value of Timken-equipped railroad car journals.

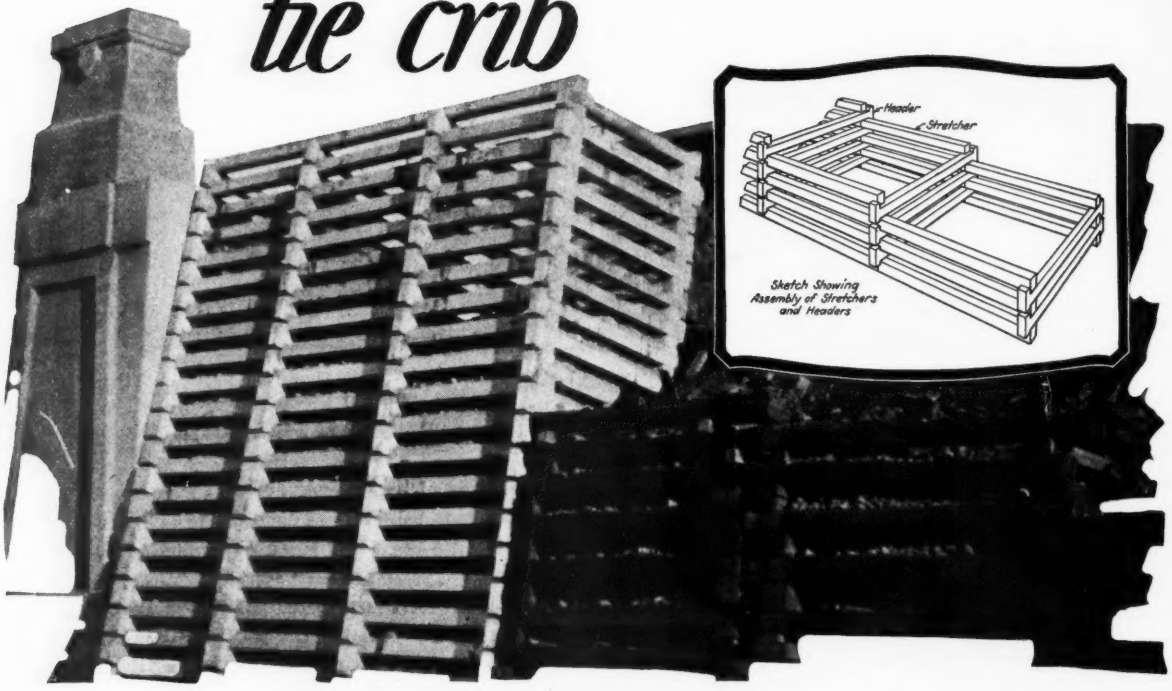
They have the capacity, because Timken Bearings are more than equal to the tremendous shock and side-thrust, as flanged steel wheels race over steel curves, crossings and switches. Compactly, simply, with absolutely no axle wear, *ALL* stress is amply provided for by Timken material and design—Timken-made electric steel; Timken tapered construction; and Timken *POSITIVELY ALIGNED ROLLS*, considered the greatest bearing advance since the advent of the taper principle.

Journals are permanently protected. Gone are hot-boxes, endless lubrication, and rough starting. Labor, fuel and materials are saved. Upon request any railroad may have the data resulting from years of Timken development.

THE TIMKEN ROLLER BEARING CO.
C A N T O N , O H I O

TIMKEN *Tapered Roller* **BEARINGS**

As easy to lay as an old tie crib



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THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

Installation for one of the largest gas companies in the middle west. 12" plain end deLavaud pipe with Dresser type couplings.

The smooth exterior of deLavaud Cast Iron Pipe makes it ideal for use with special couplings

IT has long been a standard practice to use couplings of the Dresser type for high pressure lines.

For water or natural gas lines this joint may be equipped with regular rubber gaskets. For lines conveying manufactured gas, lead tipped gaskets are generally specified.

Write for descriptive literature on special couplings for all purposes

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Pittsburgh: 6th & Smithfield Sts.
Dallas: Akard & Commerce Sts.
Kansas City: 13th & Locust Sts.
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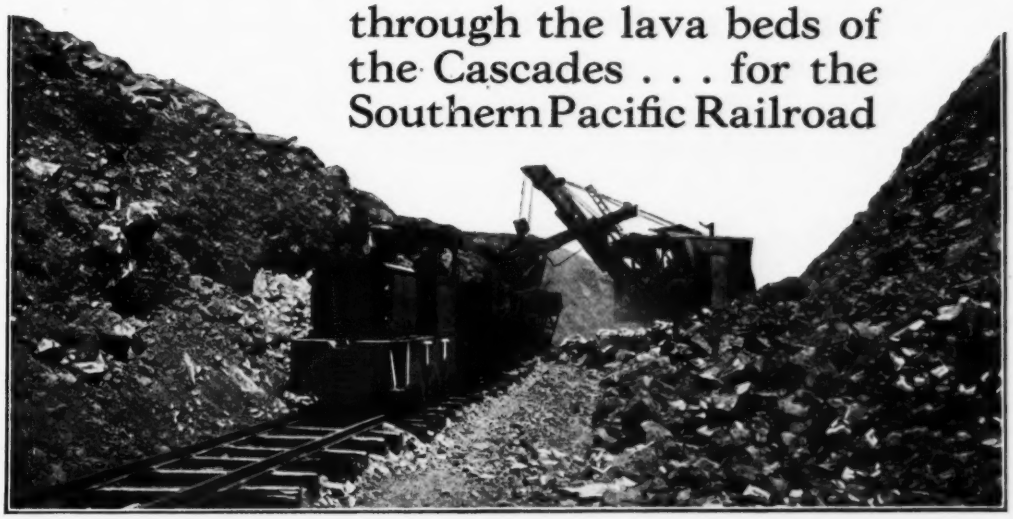
DU PONT DYNAMITE MAKES THE GRADE

through the lava beds of the Cascades . . . for the Southern Pacific Railroad



IN order to eliminate a 731.1 foot grade either way over the Cascade Mountains, the Southern Pacific Railroad spent $4,000,000 for the 24 mile Black Butte-Grass Lake cut-off rounding out the more extensive Natron cut-off project.

The Utah Construction Company, Ogden and San Francisco, who were awarded the contract, had to rush the cut-off through one of the few and one of the largest lava beds in North America, a formation that resisted vertical drilling so that drilling had to be done just ahead of the steam shovels. Water had to be pumped from distances as great as three miles. Sand, mixed with recent volcanic boulders, persisted in filling in the excavation.

In less than a year, eight subcontractors working at the same time, blasted, dug out and hauled away approximately 1,865,000 cubic yards of the hardest material imaginable. See panel for their records.

The Heiselt Construction Company alone, on their part of the job, used nearly 200,000 pounds of 40 per cent du Pont Quarry Straight Dynamite. Literally carloads of explosives were fired in eating a way through this extremely hard lava rock formation.

The Southern Pacific men associated in this job were George W. Boschke, chief engineer; A. E. McKennett, division engineer in charge of this work; and R. E. Kelly, development manager.

Wherever the unusual, the difficult, the outstanding—there you'll find du Pont explosives and du Pont field service men.

Caldwell Construction Co.	
2½ miles	200,000 cu. yds.
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4.88 miles	500,000 cu. yds.
L. R. Wattis Co.	
1.34 miles	125,000 cu. yds.
Rajotte Winters, Inc.	
3½ miles	140,000 cu. yds.
Otto Hansen Construction Co.	
2.63 miles	180,000 cu. yds.
Paul J. Tyler	
5.75 miles	320,000 cu. yds.

E. I. DU PONT DE NEMOURS & CO., Inc.
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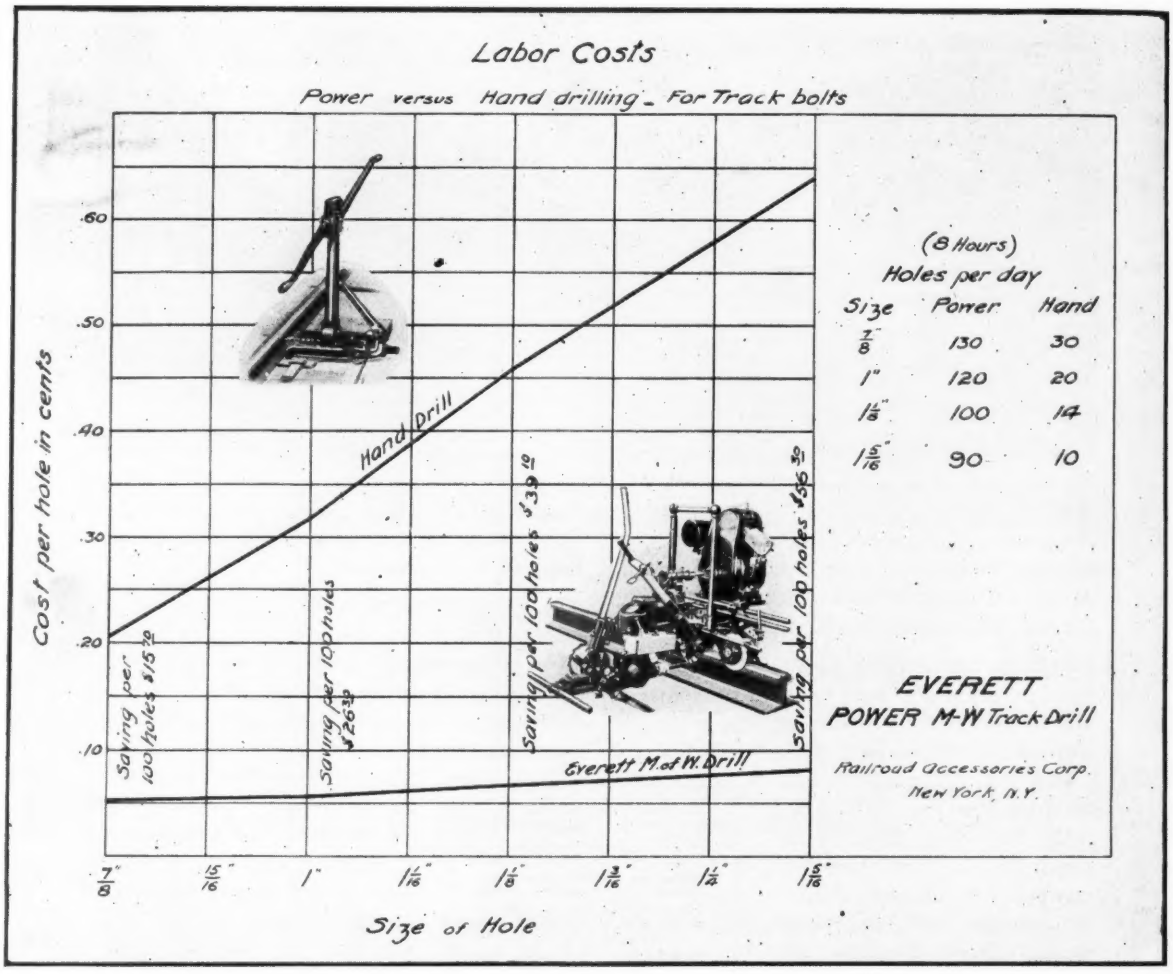
125 YEARS OF LEADERSHIP IN THE SERVICE OF INDUSTRY

Why You Can No Longer Afford To Drill Bolt Holes By Hand



IN ADDITION to the savings effected in drilling, the Everett Power M-W Track Drill can now be equipped with a chuck that will run up nuts to within one-half turn of permanent tightness.

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Railway
Engineering and Maintenance

Volume 23 July, 1927 Number 7

WORK TRAIN ACCIDENTS

THIS is the season of the year when work trains are employed in the largest numbers by the maintenance of way department. It is also the period in which the largest number of accidents occur in which trains of this character are involved. While the control of these trains is in the hands of the transportation department, the fact that they are engaged in maintenance of way work and manned, with the exception of the train crew, with maintenance of way employees, makes the control of accidents to work trains of direct interest to maintenance as well as transportation officers. From the very nature of the service, the operation of a work train is subject to special hazards. It is employed principally on the main tracks. Its operations can be scheduled only in a very general way and they frequently extend over a considerable section of line. Furthermore, it is not only earning no revenue but is itself a source of heavy expense.

It is incumbent on the maintenance of way department, therefore, to insist that every minute possible be utilized in work, for the delays incurred in clearing the main tracks for traffic are necessarily heavy. With the exception of the control of the train from the operating standpoint, the work train usually operates under the direction of a roadmaster or maintenance foreman. This officer can do much to reduce the hazard of the work and at the same time increase the volume by giving the most careful consideration to its planning. Nowhere can a resourceful man show his ability more fully than in the way he conducts his work train operations.

WITH THE RAIL ALL LAID

THAT maintenance of way officer who relaid his rail during the winter or early spring can now view the summer's activities with far more complacency than his neighbor who is still facing this task in addition to his ballasting, ditching and other heavy seasonal work. In this he is realizing one of the outstanding benefits from this practice.

The summer is at best a period of stress for maintenance of way forces because of the large amount of work which must, of necessity, be done at this season. Every task which can, therefore, be transferred to another less active season, not only reduces the pressure at the peak but also increases the efficiency with which the other operations can be conducted by permitting a greater degree of concentration on them.

It is a basic principle of industry that regularity of production contributes to economy of output. Uniformity of forces cannot be attained or even approached on most roads. They can, however, go further in this direction than they have yet gone. The laying of rail is one of the tasks which it has been demonstrated can be done without disadvantage in practically any part of the country in a normal winter. With this out of the way, foremen and their supervisory officers can give their attention to the prosecution of a more orderly program. With this work to be done, in addition to the other work, however, more men, usually inexperienced, must be recruited, organized and trained. More foremen must be taken from their regular work and supervisory officers must "spread themselves out that much thinner." The effect of this concentration of work is not confined to the immediate tasks in hand, but it extends throughout all of the roadway operations for even the routine operations of renewing ties and of lining and surfacing track are held back until the heavier work is done. This retarding influence extends to the end of the season and is reflected in a frantic rush on many roads to close up their work in the fall with the frost catching many details unfinished. That maintenance officer who has his rail in can work towards the end of the season with far less dread and his track will go into the winter in better condition and without the wasteful expenditure that always accompanies haste.

SAFETY IS "MY JOB"

EVERY railway employee is familiar with the announcement made by the Safety Section of the American Railway Association in 1923 challenging the railways to make a reduction of 35 per cent in accidents by the end of 1930. Every employee is sympathetic with this objective and hopes that it will be attained. Yet one may ask what the individual employee is doing to bring this about.

Data just completed by the Safety Section show that real progress has already been made by the railways of the country as a whole. At the end of 1926 forty-four roads had already attained the 1930 objective, while sixty-one other roads have kept abreast of the program to date. On the other hand, 39 other lines have fallen short of the schedule so far and 43 roads have not only failed to effect any reduction in accidents but actually show increases as compared with 1923. It is evident, therefore, that there is still much to be done.

In a circular just issued, the Safety Section puts the problem directly up to each foreman and supervisory officer in the words "You must reduce your *own* accident rates 35 per cent over *your own record* for 1923." In other words, this is no abstract campaign which concerns only the system officers but a very real problem for *each* foreman and supervisor on his *own* territory. The question may therefore be raised very properly with every such local officer as to what measures he himself is taking to reach the goal on his individual territory.

Most accidents result from faulty practices, relatively few from defective materials. Practices are within the

control of the man on the ground. It is he who instructs his men how to go about their work. He also supervises them to see whether they follow instructions. If they deliberately disregard orders, discipline should be applied.

Most accidents are avoidable and as such constitute a reflection on those among whose forces they occur. When each local officer determines that there will be no more reflections on his ability on this score, the problem will largely be solved for he will then see to it that those working under his direction avoid accidents. In other words, when the railway's job becomes "my job" with each foreman and supervisor, it will be accomplished.

WATER SERVICE IS A SPECIALTY

THE supplying of an adequate quantity of water of a quality suitable for use in locomotive boilers is an important element in railway operation on all railroads and must be directed with intelligence and skill. When this particular activity is attended by obstacles such as are encountered on the Santa Fe coast lines as described on page 282 of this issue, it is especially important that it be in the hands of men having a particular fitness by training, experience and inclination. There was a time when water service was considered purely a side line for an officer engaged primarily in other activities, usually bridge and building work. But those were the days when a typical water station consisted of a tank with a spout supplied with water from a nearby stream by a simple steam plant. Today there are so many special problems to engage the attention of the man in charge of water service and so much equipment, designed especially for use in this particular field, that he cannot expect to be qualified to deal with them intelligently unless he is enabled to devote his entire time exclusively to water service problems.

WELDING IN BRIDGE WORK

THE strengthening of the Chicago Great Western bridge over the Missouri river at Leavenworth, Kan., by electric welding, as described on page 279 opens a new field in bridge reinforcing methods. Electric and gas welding are used extensively in the industries. Gas welding as applied to the building up of battered rail ends is familiar to every maintenance of way man, while electric welding is equally common in railroad shops. But for reasons which need not be entered into here, welding has made but a bare start in structural steel fabrication. It has been used to some extent in steel building construction, but not at all for bridges.

Whether or not autogenous welding is ever found to have advantages in steel construction which will result in the supplanting of the riveted joint by the weld, it is certain that welding possesses particular advantages over riveting in the reinforcing of old structures. Perhaps it would be better to say that riveted work is at a particular disadvantage in applying new metal to old and that, therefore, any method which avoids the cumbersome field drilling and cutting of rivets that is necessary before a new plate or angle can be applied to an old member could hardly help being an improvement.

The promotion of welding as a substitute for riveting is at a disadvantage because of the lack of any known method of testing a weld without destroying it. There is no counterpart in welding for the usual practice of testing rivets which plays so important a part in the building of steel bridges. It is the resulting lack of confidence as much as anything else, which has been responsible for the slow advance of welding in this particular field.

The reinforcing of old bridges offers an opportunity for the employment of the new method of joining structural members in a way that is less of departure from accepted practice, since a bridge strengthened by welding is not entirely a welded structure but a combination of a riveted and welded frame. Moreover, it is possible by test and careful inspection to observe the effectiveness of the added material. Thus on the Leavenworth bridge, the application of new steel was attended by an appreciable reduction in vibration. The article also describes the manner in which new cover plates were clearly shown to be taking part of the stress of compression members. Reliability of welds, however, must be determined by repeated inspections, carried on over considerable periods.

INSPIRATION IN THE EXPERIENCES OF OTHERS

SEVERAL significant realisms should be readily apparent to anyone who has followed closely the seemingly large number of advancements which have taken place among higher railway engineering and maintenance officers during the past few months, and particularly to those who are acquainted with these men or who have studied the biographical sketches of their railroad careers as published in *Railway Engineering and Maintenance* from month to month. Primary among these, possibly, is the categorical fact that such officers are not born or miraculeously vested with the robes of authority, but, rather, are developed after long years of actual experience and study to fit them for the responsibilities with which they have been entrusted. Apparently little else definitely has an important influence other than indomitable perseverance and ability, supplemented by a reasonable amount of personality; for it may have been noted that some of these officers were born in this country, others in another; some received a higher education, while that of others was lacking; and that some have had a most settled career, while others have experienced wide and diversified employment. One thing is common to all, however, and should be noted with some satisfaction and inspiration to those in the ranks, and that is, that all, irrespective of seeming advantages that may or may not have been theirs, have started at or near the bottom of the ladder and have worked their way up, step by step.

SPEED VERSUS QUALITY

ONE OF the interesting developments in maintenance of way work in the last few years has been the direction of effort toward the establishment of records in the performance of certain tasks. This tendency has been particularly pronounced in the laying of rail, largely because of the fact that the amount of work done can be measured readily. It has also been evident in the renewal of ties, in ballasting and in a number of other operations. Records are being established on one road or division, only to be excelled on another, and are being held before gangs more than ever before to stimulate them to greater effort.

These records are attracting a great deal of interest and are giving rise to much discussion. Much of this discussion has been critical, emphasizing the con-

tention that quality of work is being subordinated to quantity, and it must be admitted that not a few illustrations can be cited in support of this position. If this criticism is inherent in any plan for the stimulation of production the consequences are far reaching. The problem is to determine if this is so.

It is capable of demonstration that any normal man will do more work when his sporting instinct is aroused. The stimulation of rivalry between gangs or the fixing of a goal to be attained is an appeal to this instinct. Any man will work harder than usual to beat an opponent or to establish a new record. The increased output accrues to the advantage of the road. A supervisory officer who fails to recognize and to take advantage of this trait in human nature falls short of his responsibilities.

Confronted with this opportunity to increase the output of his forces, the problem of a supervisory officer is not to ignore it because of the dangers of over-enthusiasm but to utilize and control it so that the quality of the work will be upheld. This is not impossible for it has been demonstrated on numerous occasions that men will do what they are required to do but little more. The quality of the work secured depends therefore on the degree of supervision exercised. This is true of all work although it applies more forcibly when a premium is placed on output. A supervisory officer can get any standard of work he desires if he will insist on it. That officer who opposes the stimulation of rivalry because he fears that the quality of the work will decline, confesses, by this attitude, his inability to supervise the work of his forces thoroughly and by this attitude loses for his company the increased output possible.

KILLING WEEDS

IF ONE were to compare the maintenance methods of today with those of 10 or 20 years ago, one of the changes which he would note would be the increasing attention that is now being paid to refinements in many practices. Nowhere is this being given more consideration than in the eradication of weeds from the track section. Whereas weed elimination was formerly considered a problem on many lines only when they interfered with train operation, it is now considered very generally as an aid to good track maintenance itself and worthy of attention from this standpoint alone. This has come about in part from a growing realization of the destructive effects of vegetation on ballast, on ties and on the maintenance of good line and surface. It is also in no small measure a reflection of the development of improved and more economical methods of controlling weed growth.

With the introduction of the consideration of economy has come the question of how far one is warranted in going to eliminate weeds. This question has been brought prominently to the fore by the acute competition of late between companies promoting the destruction of vegetation by chemicals. Although the principle has long been established that in the long run one gets today only what he pays for, the roads have encouraged the weed killing companies to cut prices severely by playing one against the other in the thought that they were saving money, whereas in most cases the inevitable result has been that they have forced these companies to weaken their treatments. This raises the question of the tolerance point in vegetation or, in other words, that of the degree of thoroughness with which a road desires its work to be done.

Even though the control of vegetation may be considered a detail of maintenance work, it is one for which those roads with high maintenance standards spend large sums of money. Where chemicals are used a high degree of technical knowledge is required, which knowledge the average railway does not possess. The economical treatment varies with different types of vegetation and with the relative prevalence of seedling and of perennial growths. It varies also in different sections of the country. All vegetation, however, regardless of its type or location, has a "tolerance point" below which it may be sickened by the application of a chemical but will later revive and above which it will be killed.

Because of this variation in killing strength required, many roads feel that they are effecting real economies by decreasing the strength of their applications. This point of view has been strengthened by the active competition between the promoters of these materials with the result that much track is today receiving treatment that is only partially effective. This situation is further complicated by the fact that few roads are prepared to determine whether any new growth that appears is seedling growth or the result of incomplete killing of old growths. Another phase of this subject, largely undecided as yet on most roads, is the economy of giving a sufficiently heavy application the first year to kill all perennial growth and then follow with lighter treatments in succeeding years to keep down the seedling growth, as compared with a cheaper but less thorough first treatment with its necessarily heavier treatments in following years.

The demand for weed eradication is an outgrowth of the rising standards of track maintenance. It will become increasingly important in the future. There is a need, therefore, for the more thorough consideration of this subject on the part of many roads in order that they may compare their costs and select their treatments on the basis of accurate comparative costs *for given results* rather than on first costs and casual inspections.

New Books

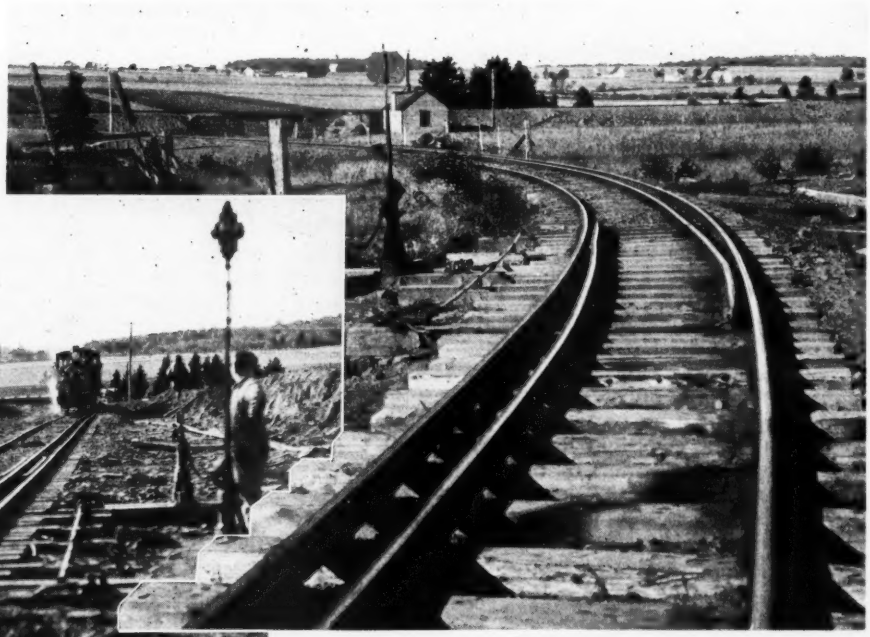
Manual of the Endurance of Metals Under Repeated Stress. By H. F. Moore, research professor of engineering materials, University of Illinois. 5 in. by 7½ in. 63 pages. Bound in cloth. Published by Engineering Foundation. Price $1.00.

The breaking of a part in a machine or in some structure after long use but under loads that result in stresses well within "safe" limits has given rise to much misunderstanding. Many people have referred to such a break as resulting from "crystallization," but it has been definitely proved that no crystallization takes place. More recently the term fatigue of metals has been popular, but even this does not describe what actually takes place. In view of this popular misunderstanding of what causes metal members to fail under repeated loads, this little book meets a well-defined need for it presents a brief outline of the present knowledge on the subject as it has been evolved from investigations here and abroad. The treatment employs a minimum of technical terms and should prove of definite value to the man who desires a general knowledge of the subject, but doesn't care to undertake an exhaustive study.

TEN YEARS AGO.—Plans for the employment of women in positions which usually are filled by men on the larger railroads are apparently keeping pace with the resignations of men who are leaving their positions through the demands of the war.—*Railway Age Gazette.*

Changing a Railway from Narrow to Standard Gage

How This Kind of Work Has Been Carried Out Successfully on the Prince Edward Island Lines



At the Right—Arrangement for Changing Third Rail from Left Hand to Right Hand on a Wye

At the Left—Junction of the Borden and Kensington Sub-Divisions at Emerald Junction

PROMPTED by the need of better transportation facilities and a closer and more direct contact with the rest of Canada, the railway of Prince Edward Island has undergone a most interesting transformation during the last nine years. This has been brought about by the gradual but consistent work of standardizing the gage of the tracks on the various sub-divisions so as to make it possible to operate through trains from the mainland of the Dominion to all of the principal cities of the island. This work, which was begun in 1916, has to date extended over 224 of the 276 miles of lines on the island, and in addition to the actual widening of the gage, has included the necessary work of widening the roadbed, lengthening the culverts, replacing and strengthening the bridges, and altering or replacing many roadway and shop facilities.

With all of this work involved, standardization of the entire line, under the conditions existing, was too large a project to undertake at one time, so the work thus far completed was divided into three distinct projects. In the first of these, which included the central section of the railroad connecting the main port of entry from the mainland with the principal cities and towns of the island, it was deemed advisable to provide for both standard and narrow gage operation at the same time, so that the full benefit of true standard gage operation between points on the mainland and the principal shipping centers of the island could be realized at once, and at the same time not interfere with narrow gage operation on the island until the gage of the remaining important lines could be standardized. In accomplishing this about 60 miles of third rail was laid in conjunction with the existing narrow gage tracks, and many interesting combination standard and narrow gage turnouts were installed.

When this work was completed there yet remained the standardizing of the gage of the tracks at the west and east ends of the island. In handling the work in these territories, direct change-overs from narrow to standard gage were made without the third rail construction and the work was completed in each case by special forces within from 13 to 15 hours.

Adequate Transportation a Long-Standing Problem

The insular Province of Prince Edward Island, which has a maximum length of about 150 miles and a breadth varying from 4 to 34 miles, is the smallest province of the Dominion of Canada and lies in the southern part of the Gulf of St. Lawrence, separated from the mainland of New Brunswick by Northumberland Strait which varies from about 9 to 30 miles in width. Until 1873, when the Province of Prince Edward Island came into the Dominion, the capital city, Charlottetown, and the other principal cities, were without any form of a connected railroad. About that time, however, the government of the island was constructing a railroad of 3 ft. 6 in. gage from Charlottetown westward to Tignish at the ex-

treme northwest end of the island, and eastward to Georgetown and Souris in the eastern half of the island, a total distance of about 195 miles. This railroad, which was completed by the Canadian Government, has since been extended, as shown in the accompanying map, until the present road, now the Island division of the Canadian National, is about 276 miles long and reaches all of the important cities and towns of the island.

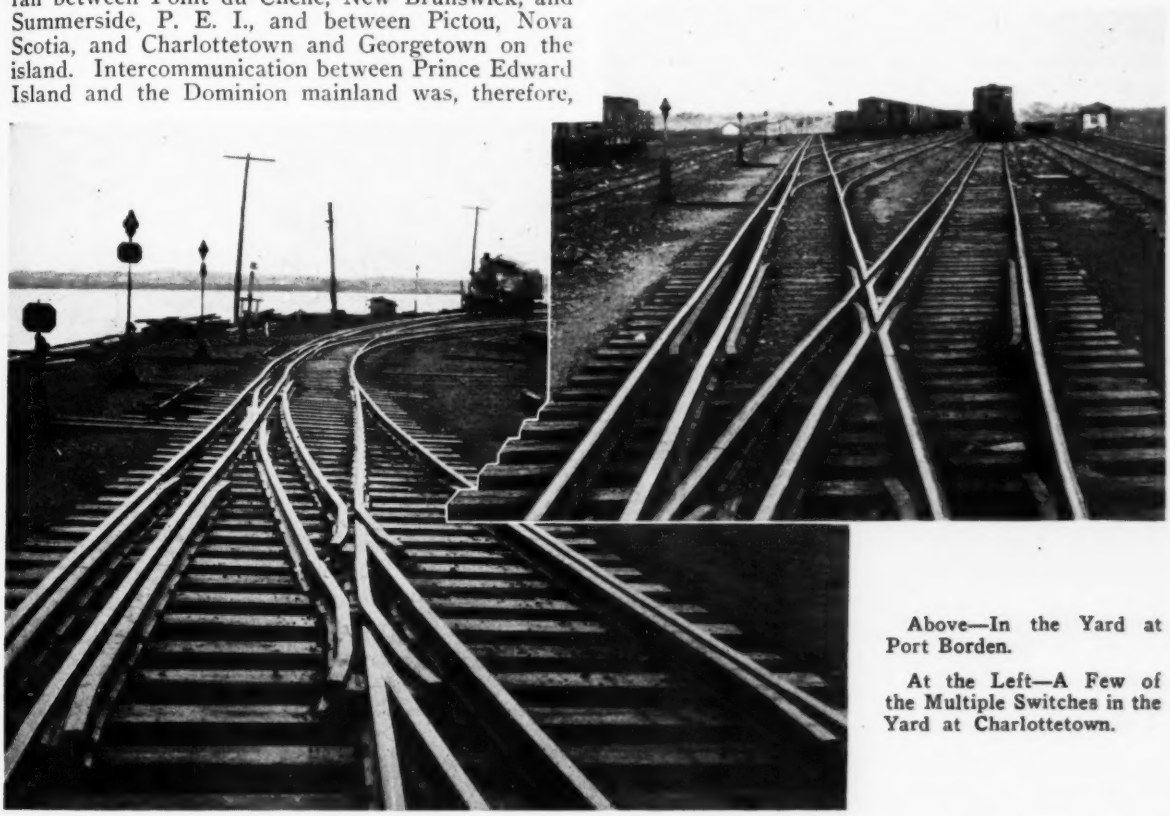
Inadequate Connection with Mainland

While this road afforded adequate inter-city transportation on the island, it did not have any direct connection with the mainland of the Dominion, the only means of communication being the steamships which ran between Point du Chene, New Brunswick, and Summerside, P. E. I., and between Pictou, Nova Scotia, and Charlottetown and Georgetown on the island. Intercommunication between Prince Edward Island and the Dominion mainland was, therefore, unsatisfactory under the most favorable conditions, and particularly so during the winter and spring seasons when even this communication was seriously interrupted and often cut off entirely by the ice conditions in the intervening strait.

With this condition, and with the growth of traffic to and from the island, it became highly advisable to establish better facilities for handling the increasing amount of freight between the island and the mainland. In providing this, a car ferry route was established in 1917, between Cape Tormentine in New Brunswick and Port Borden on the island, the ferry used in this service being a strongly constructed ice-breaker with accommodation for 12 standard gage freight cars. With this ferry, regular intercommunication between the land and the mainland has been maintained with little interruption to the present time, in spite of the bad ice conditions which occur yearly.

While this established method of communication greatly regulated and accelerated inter-province freight movements, there remained the problem presented by the existence of standard gage tracks on the mainland and narrow gage tracks on the island, a problem which necessitated the transferring of all freight shipments from standard to narrow gage equipment or vice versa, at Port Borden, this being effected in sheds and on elevated trestles constructed for the purpose. There was also the problem of transferring passengers at this point, which not only caused inconvenience to the passengers, but also serious delays in many instances. Coupled with these problems was that presented by the limited capacity of the narrow-gage equipment. With the narrow gage, engines of from 10,000 to 15,000 lb. tractive power were the largest used, and, although it might have been possible to have secured heavier narrow-gage engines, it was not deemed desirable or economical to make any new purchases of narrow-gage equipment. The freight cars on the island railway were also a limiting factor, having capacity only of from 17 to 20 tons, and furthermore, there were no narrow-gage refrigerator cars on the line to handle the considerable quantities of fresh vegetables shipped from the island yearly. With these handicaps, which became more inconvenient and costly as passenger, express and freight traffic increased, it was apparent that the solution of the problem lay in the standardizing of the gage of the island railway to permit heavier loading and the through operation of Canadian National trains. Recognizing this, a program was mapped out for the standardizing of the track gage on the island, and, beginning with the spring of 1916, all tie renewals on the island lines were made with 8-ft. standard gage ties instead of the shorter ties used with the 3-ft. 6-in. gage.

As it was thought advisable to provide standard gage tracks first from Port Borden to Summerside on the west and Charlottetown on the east, thus con-



Above—In the Yard at Port Borden.

At the Left—A Few of the Multiple Switches in the Yard at Charlottetown.

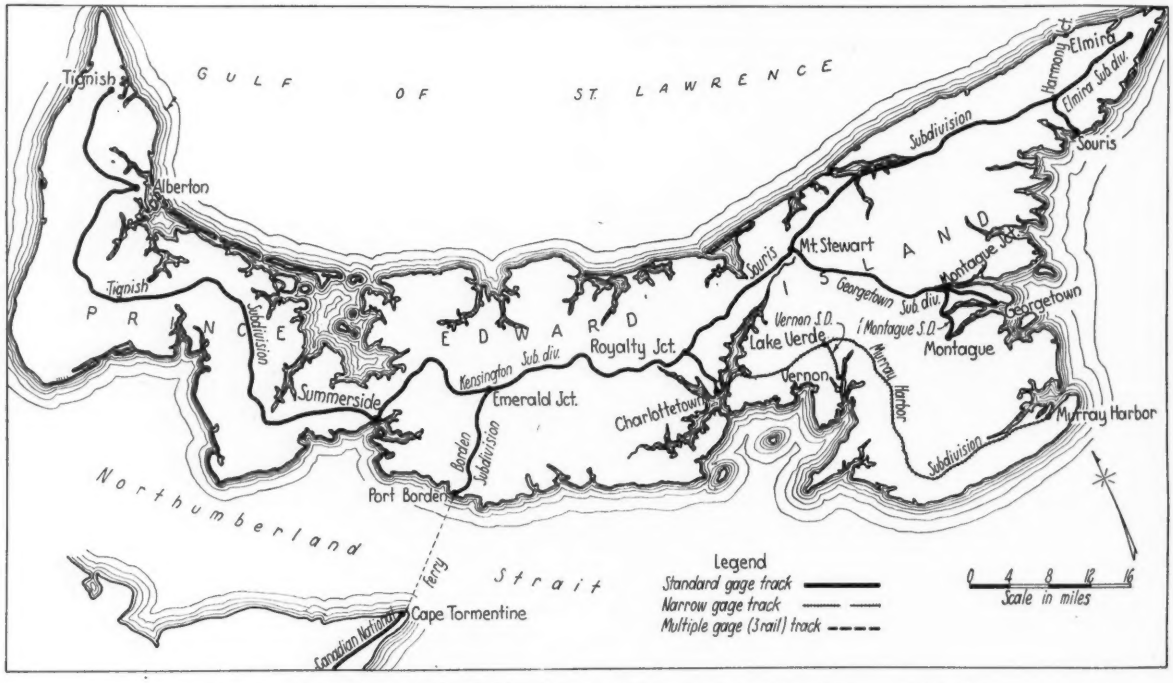
necting the two main business and shipping centers of the island with the car ferry at Port Borden, work on this territory was given preference over that which was being carried out on the lines west of Summerside and east of Charlottetown. Working under this program all of the ties on the 12-mile line from Port Borden to Emerald Junction and on the 48-mile line from Charlottetown to Summerside were replaced by standard gage ties by August, 1918, this work being accompanied by the widening of embankments and cuts, and the lengthening of existing culverts where this was necessary. Widening of cuts and the establishing of new ditches were carried out by means of a ditching machine erected on a standard flat car body with narrow gage trucks, the excavated material being used to widen fills and to strengthen the roadway.

was overcome by the use of wooden shims under the lighter rails so as to bring the tops of all three rails in the same plane.

Difficulties Encountered

While this arrangement worked satisfactorily in providing for standard and narrow gage operation over the same roadbed, it presented some difficulties. The more important of these consisted of holding the shimmed rail to gage, the replacement of worn shims, the removal of snow from the track during the winter, and the unequal thawing of the track owing to the greater shade on the side where the rails were close together. All of the difficulties were overcome however, in one way or another, and with careful maintenance little trouble was experienced.

With such a layout, the special trackwork through



Map of Prince Edward Island, Showing the Present Railroad and Gage of Tracks

With this work out of the way, all was in readiness for standardizing the gage of the tracks to Summerside and Charlottetown. In accomplishing this, a third rail was laid in all of the tracks between Port Borden and these points so that both narrow and standard gage equipment could be operated directly. Placing of the third rail, which was laid to standard gage with one of the rails of the narrow gage track, was carried out without much difficulty and without any interference to traffic, this work involving merely the gaging and spiking of the new rails in position.

As the original narrow gage track consisted of about 38 miles of 56-lb. rails and 22 miles of 50-lb. rails, both of which sections were considered of insufficient strength to carry standard gage equipment, the new third rail was laid with 67½-lb. rails, which in turn necessitated the relaying of the outer rails of the narrow gage track with 67½-lb. rails, owing to the fact that the lighter sections of rail were about one inch less in height than the rails of the new section. Relaying of the outside rails then gave a narrow gage track with 67½-lb. rails on the outside and 50 and 56-lb. rails on the inside, a condition which

turnouts was necessarily somewhat complicated, but each problem presented was met in a satisfactory manner with standard and special turnout parts. As an example, a study of the accompanying drawings of standard and narrow gage combination turnouts, shows the use made of two standard No. 8 rigid frogs and a special No. 13 movable or rigid, double-pointed frog. In main line tracks, where No. 13 movable point frogs were used, the points of the frogs were operated by a special double-throw switch stand, the movements of which were interlocked with the action of the switch points by means of plunger and lock rods so that it was impossible to set the points of the switch and frog on conflicting routes. In yard layouts the turnouts were of the same general arrangement as used in main tracks, with the exception that double-pointed No. 13 rigid frogs were used instead of the No. 13 movable-point frogs. While these special track arrangements slowed up the work considerably, the three-rail track system between Port Borden, Summerside and Charlottetown was entirely completed by August, 1919.

With this work completed the next step was to

standardize the gage of the track from Summerside, westward 68 miles to Tignish at the west end of the island. This work was begun in July, 1922, and, as in the case of the lines from Port Borden to Summerside and to Charlottetown, the first work was that that of widening the roadbed, lengthening culverts, and replacing the few light and narrow bridge spans with new ones suitable for standard gage equipment. Other preliminary work in this territory included the alteration and enlargement of the engine house at Tignish, the raising of a coaling chute at this point and of a water tank at Alberton, the construction of wye tracks at Tignish and Summerside to replace the old turntables at these points, which were unsuitable for standard gage equipment, and the moving back of all freight sheds and platforms on the line to afford proper clearances.

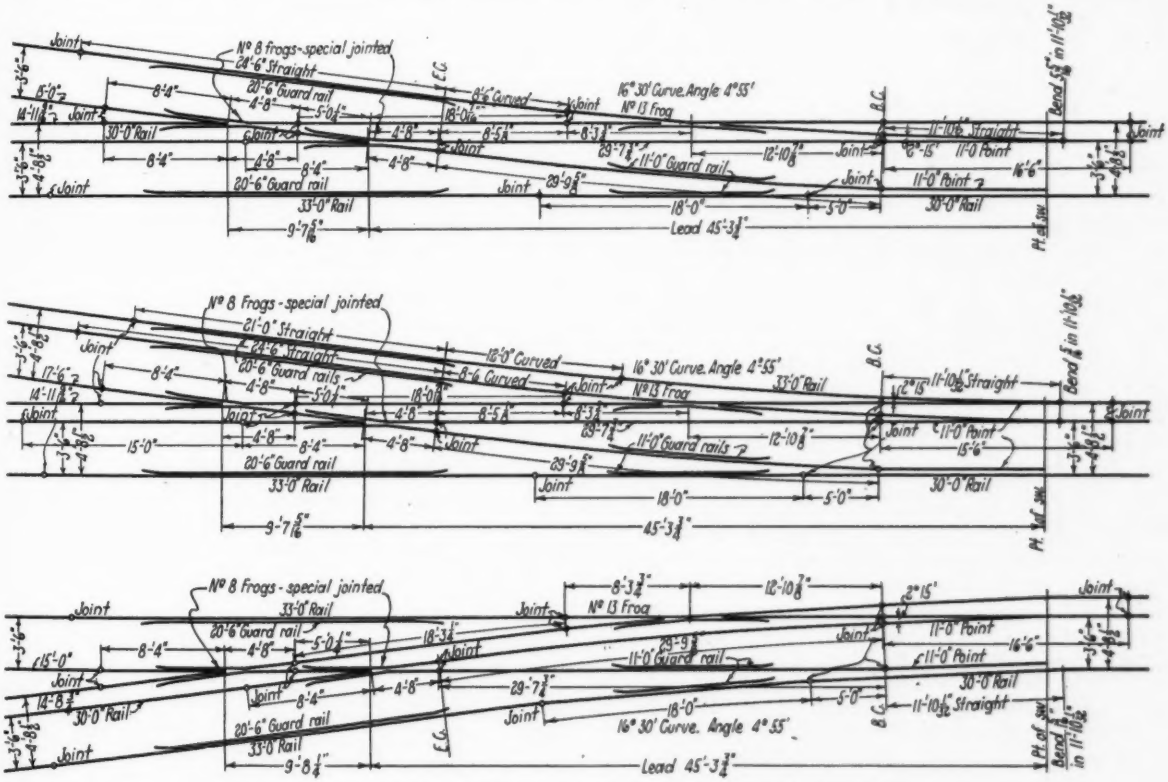
Relay Track with Heavier Rails

The narrow gage track between Summerside and Tignish was laid, for the most part, with 50-lb. rails, about 37 miles of which it was deemed advisable to replace with 67½-lb. second-hand rails for standard gage operation. Where this situation existed, the heavier rails were laid to standard gage outside the narrow gage rails and were spiked in position ready to be connected with the balance of the tracks when widened.

When this work was completed, a date was set for the complete change-over from narrow to standard gage on the remainder of the tracks, and on that date, with 11 gangs distributed over the line, the entire change was made in about 13 working hours. As the completion of this work provided standard gage tracks from Port Borden westward to Tignish, and eastward to Royalty Junction and Charlottetown, there was no further need for double-gage operation within this territory and therefore all narrow gage equipment was moved off and all of the third or center rail was taken out, except over the 5 1/3-mile line between Royalty Junction and Charlottetown, where the third rail was left in place in order to afford Charlottetown a connection with the narrow gage lines on the east end of the island.

Much Preliminary Work Necessary at East End

By August, 1924, all was in readiness to undertake the widening of the gage on another large section of the island railway, so preliminary work was started and carried out on the Souris sub-division, from Royalty Junction to Souris, 55 miles; on the Georgetown sub-division, from Mt. Stewart Junction to Georgetown, 24.1 miles; and on the Elmira subdivision, from Montague Junction to Montague, 6.5 miles; and on the Elmira sub-division, from Harmony Junction to Elmira, 9.9 miles. Over this total distance of 95.5 miles the first preliminary work was to enlarge and strengthen the existing structures to take care of the larger and heavier equipment. By far the largest part of this work was in connection with the bridges, which was in contrast with the situation on the other lines widened where the bridge work was realtively light. Here, a number of old light truss bridges were replaced by girder spans, others were strengthened and fitted with concrete slab ballasted decks, and still other bridges of various types were either replaced by short reinforced concrete spans or by fills and various sizes and types of culverts. Another important part of the work in this connection was the replacing of old masonry and pile bridge abutments and piers with concrete structures, the renewing of bridge seats, and in every instance where



Details of Three of the Standard and Narrow Gage Combination Turnouts

salt water was encountered, the facing of the new piers and abutments with granite to prevent deterioration. While this work took considerable time and effort, none of it presented any unusually difficult problems as all of the bridges were relatively short and light.

In May, 1926, track work preliminary to actual gage widening was begun, this consisting of the distributing and driving of the outside rows of spikes for the new gage, the distributing and preparation of standard gage switch materials, the renewal of a considerable mileage of light section rails, and the alteration of such yard tracks as could be accomplished without interference to the movement of narrow gage equipment. In the preliminary spiking, about 9,000 spikes were distributed to the mile, and with these, two new outside rows of spikes were driven, to which the rails could be thrown when actual gage widening was under way. The new spikes remaining after this work was completed were left in place to supplement the old spikes to be released later and to be used in forming the inner rows of spikes on the rails when thrown to standard gage. This spiking was done by a gang of about 12 men with a special gage or template which fitted against the old rails and marked the positions of the spikes to suit the new gage. The men on this work also did such adzing of the ends of high or rail-cut ties as was necessary to form level seats for the new positions of the rails.

Replacing the Switches

While this work was going on, five gangs of about 18 men each were engaged in preparing split switch turnouts to replace the narrow gage stub switch turnouts then in service, this work involving the bolting-up of the lead rails to the frogs ready to lay as a unit, and at some of the more important sidings, the laying in of the turnouts complete with standard lengths leads, although this arrangement did not quite suit the narrow gage track. In addition to the above, the old light rails of the entire Montague subdivision were renewed with 67-lb. rails, and four miles of track east of Royalty Junction on the Souris subdivision was relaid with 80-lb. rails, in each case, as on the Tignish sub-division, the heavier rails being spiked to standard gage outside of the narrow gage rails and in no way interfering with them.

By Saturday, August 21, 1926, all of the work preparatory to the actual widening of the gage had been completed and all of the narrow gage equipment, with the exception of two trains, had been moved off of the narrow gage territory. The two remaining trains, which were from Charlottetown, arrived at the Georgetown and Souris terminals at 9 and 9:30 p. m. respectively on the night of the 21st, and in order to get them off from the territory before the morning of the 22nd, when the gage was to be widened throughout, they were returned to Charlottetown promptly upon their arrival at their destinations, rather than being held over until their schedule return on Monday morning, August 23.

Complete Change-Over in About 13 Hours

With the tracks thus cleared, the actual gage widening was begun at 5:30 a. m. on Sunday, August 22, with special track forces which had been organized previously for the work. These forces consisted of 14 gangs of from 35 to 45 men each, which assembled at designated points along the line and worked continuously to the east or west until they met an opposing gang or closed in with the widened gage started by the gang ahead of them. As lined up, each gang was assigned from about 3 to 7 miles of track, depending largely upon the amount of switch work to be done, and thus assigned, the 14 gangs covered 85 miles of tracks on the Souris, Georgetown and Montague sub-divisions, widening the gage throughout, in addition to completing the installation of wyes and turnouts at Harmony, Mt. Stewart and Montague Junctions and standardizing the gage of important sidings at a number of points.

How the Work Was Done

With so much of the preliminary work out of the way, the work of actually widening the track gage was comparatively simple. In accomplishing it the men of each gang were lined up about as follows: six to eight men pulling inside spikes, three or four men throwing the rail inward from the outside spikes, six men then lining the rail outward against the outside spikes previously driven for standard gage, and the remainder of the men full spiking the rail in its new position. While this organization was varied slightly in some instances in order to keep the work balanced, it was generally maintained intact except when changing over turnouts, where it was necessary to reassign the duties of a number of the men while the rest carried on the regular gage-widening work in the usual manner. Working under this organization the various gangs pushed on with their work, three completing their assignments by 3 p. m. while the other gangs closed in on each other at various times between 5 and 6:45 p. m.

Thus within about 13 hours the complete change-over was made from narrow to standard gage on 85 miles of line, and with the exception of minor work at the larger terminals, the tracks were ready for the operation of standard gage trains. That such was the case is evidenced by the fact that even before the last rails had been thrown to the new gage, standard gage trains were sent out from Charlottetown for Souris and Georgetown, arriving at their respective destinations by 8:35 and 9 p. m., ready to make their scheduled runs westward on Monday morning.

Some Changes Still to Be Made

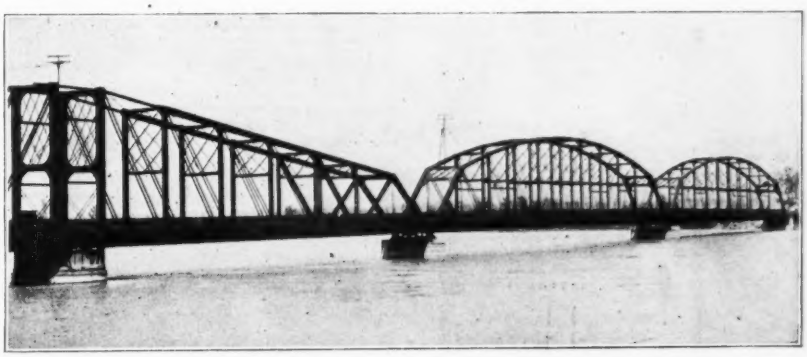
While the standardization of the track gage on the 9.9 miles of the Elmira sub-division had been included originally in the program to be carried out on August 22, lack of materials made it necessary to hold up the work on this line until the following week, during which, while traffic was abandoned, the remaining tie renewals were completed and the rails relaid to standard gage.. With this work out of the way, all of the mileage of the Prince Edward Island Railway, or the Island division of the Canadian National, with the exception of the 52 miles of the Murray Harbor and Vernon sub-divisions, is now standard gage, and the long-standing transportation problem of the island has been solved as standard gage equipment now moves freely between the mainland and all of the principal cities and towns of the island province. The only multiple gage or three-rail track now remaining is a small amount in the Charlottetown wye and yards where it serves for interchange purposes between the new standard gage lines and the narrow gage tracks of the Murray Harbor branch.

We are indebted for the information contained in this article to C. B. Brown, chief engineer, operation department of the Canadian National Railways, under whose direction the gage-widening operations have been carried out.

Electric Welding Reduces Cost of Strengthening Bridge

Chicago Great Western Avoids Much Drilling and Riveting in Applying Reinforcing Plates to Leavenworth Structure

WHAT is believed to be the first application of electric welding in the reinforcing of a bridge was carried out during the early part of the present year when the superstructure of the Chicago Great Western's bridge over the Missouri river at Leavenworth, Kan., was strengthened by adding cover plates to certain members. This bridge is owned by the Leavenworth Terminal & Railway Bridge Company, a subsidiary of the Great Western, and comprises an important link in the Southern division of that road which extends from Oelwein, Iowa, to Kansas City, Mo.



The Chicago Great Western Bridge Over the Missouri River at Leavenworth, Kan.

The bridge was built in 1893, according to a design of the late George S. Morrison and consists of two fixed through truss spans 330 ft. long and a through truss swing span 440 ft. long. The workmanship on the superstructure was good and it has been maintained in excellent condition, but owing to the extremely low live loading and the comparatively high stresses used in the design, the spans have a limited load-carrying capacity. The spans were designed for a live load of 3,000 lb. per ft. of bridge without any wheel concentration or other allowance for greater weight of locomotive than the following train. The working stresses used in design conformed to a tensile strength of 10,000 lb. per sq. in. for live load and 20,000 lb. per sq. in. for dead load. The main truss members are steel and the floor and lateral system and cross bracing of wrought iron. It is not surprising, therefore, that it was necessary to restrict this bridge to comparatively light locomotives.

For passenger service use of the bridge has been confined to a Pacific type locomotive having a total weight including the tender of 329,280 lb. with 46,400 lb. on each of three driver axles. For freight service power was restricted to a prairie type locomotive having a total weight of 321,480 lb. with 48,250 lb. on each of three driver axles.

Urgent Need for Strengthening

Freight train tonnages based on the rating of the prairie type locomotive, single-headed, placed such limitations on any plans for increased operating economies that it was clear that something had to be done to permit the use of heavier power. Studies were made for a new superstructure for the bridge but the cost of this was such that the project was abandoned. A careful analysis of the old spans was also carried out with a view to ascertaining whether it would be practicable to strengthen the bridge so as to permit of the safe operation of a consolidation locomotive having a total weight of 379,500 lb. with 50,550 lb. on each of four driver axles and followed by a uniform load of 4,000 lb. per ft. of bridge, using the rules for the investigation of old bridges of the American Railway Engineering Association.

This investigation showed that no reinforcing of the draw span trusses was required but that it would be necessary to strengthen the floor beams and stringers of the entire bridge and the end posts, top chords, hip verticals and counters $L_0 U_1$ of the two fixed spans. The failure to apply concentrated locomotive loading in the design readily explains the weakness of the floor system and the hanger verticals, but the need for reinforcement of the end posts and top chords is to be accounted for in part by the faulty make-up of these members. They consist of two webs 22 in. deep with four 5-in. by 3½-in. angles and a cover plate 27½ in. wide by ⅜ in. thick. Therefore, with rivet lines in the cover plates 24½ in. apart and a thickness of only ⅜ in., these cover plates had a slenderness ratio of 1 to 64, whereas good practice limits this to about 1 to 40.

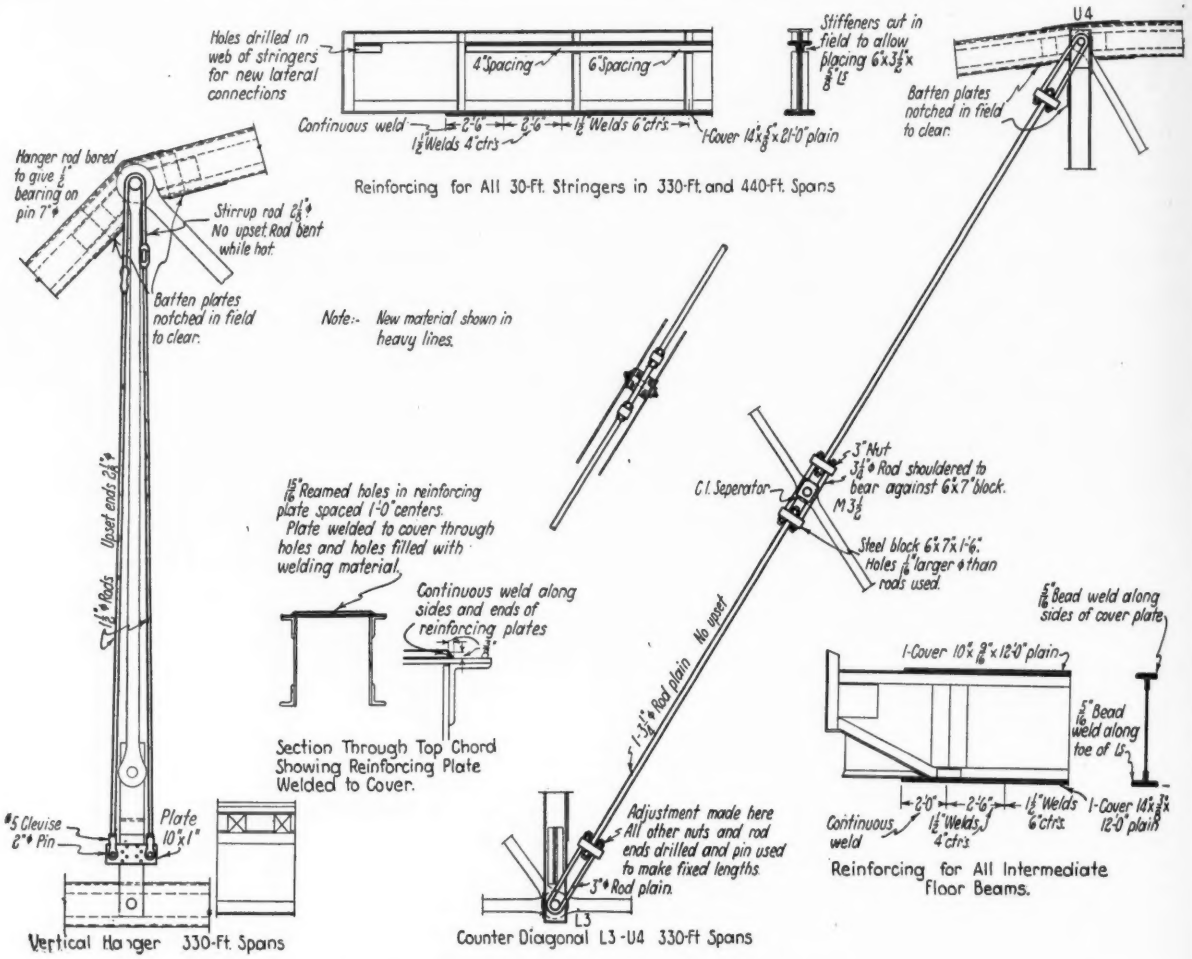
Electric Welding Suggested

It was found that the chord members of the trusses could be reinforced by adding a second cover plate, and that additional or new members would be required for the hip verticals and the inadequate counters, while additional metal would be required in the flanges of the floor beams and stringers.

A request for bids on the reinforcement work resulted in tenders covering the usual method of applying reinforcing materials as well as one in which all cover plates were to be welded in place. The latter bid was so much more favorable that after careful study it was accepted and the work carried out substantially in accordance with the submission made. The strengthening of the hip verticals was carried out by adding two rods 1½-in. in diameter attached at the top to a U-bar over the hip pins and at the bottom to plates riveted to the ends of the floor beams. The counters $L_0 U_1$ were replaced by new members consisting of a 3¼-in. rod attached at the

ends to U-bars over the pins and carried around the sub-panel points M 3½ by short rods and yokes as shown. This part of the work involves no departure from current practice. The same comment applies to the reinforcing of the top flanges of the stringers which were increased in section by riveting new 3½-in. by 6-in. by ⅝-in. angles on each side of the web just below the bottom edges of the original flange angles, the stiffener angles being notched out to make room for the new steel. As the old laterals

All of these cover plates were secured in place by bead welding along the edges. On the chord members these welds were continuous. On the floor beams the weld was continuous for 2 ft. from the ends and on the stringers for 2 ft. 6 in. from the ends, with welds 1½ in. long at spacings ranging from 4 in. to 6 in. center to center for the remaining length of these plates. In addition to the bead welding, the cover plates on the chords were stitch welded along the longitudinal center line through $\frac{15}{16}$-in. holes


Holes drilled in web of stringers for new lateral connections
4" Spacing
6" Spacing
Continuous weld
1½ Welds 4" ctrs
1½ Welds 6" ctrs
Stiffeners cut in field to allow placing 6"x3½"x⅜" L's
1-Cover 14"x⅝"x21'-0" plain
Reinforcing for All 30-Ft. Stringers in 330-Ft. and 440-Ft. Spans
U4
Batten plates notched in field to clear.
Hanger rod bored to give ⅝" bearing on pin 7"ø
Stirrup rod 2⅛"ø No upset. Rod bent while hot.
Batten plates notched in field to clear.
Note:- New material shown in heavy lines.
1⅛" Rods Upset ends 2¼"ø
1⅝"ø Reamed holes in reinforcing plate spaced 1'-0" centers. Plate welded to cover through holes and holes filled with welding material.
Continuous weld along sides and ends of reinforcing plates
Section Through Top Chord Showing Reinforcing Plate Welded to Cover.
3" Nut
3½"ø Rod shouldered to bear against 6"x7" block.
C.I. Seperator
M 3½
Steel block 6"x7"x1'-6". Holes 1⅛" larger ø than rods used.
1-3½"ø Rod plain No upset
⅝" Bead weld along sides of cover plate
1-Cover 10"x⅞"x12'-0" plain
⅝" Bead weld along toe of L's
Continuous weld
1½" Welds 4" ctrs
1½" Welds 6" ctrs
1-Cover 14"x⅝"x12'-0" plain
Reinforcing for All Intermediate Floor Beams.
5" Clevise 2"ø Pin
Plate 10"x1"
Vertical Hanger 330-Ft. Spans
Adjustment made here All other nuts and rod ends drilled and pin used to make fixed lengths.
3"ø Rod plain
L3
Counter Diagonal L3-U4 330-Ft. Spans

Various Members of the Bridge Were Strengthened

attached to the top flanges of the stringers were made of rods, they were replaced by new 3½-in. by 3½-in. by ⅜-in. angle laterals attached to the new flange angles.

New Cover Plates Welded in Place

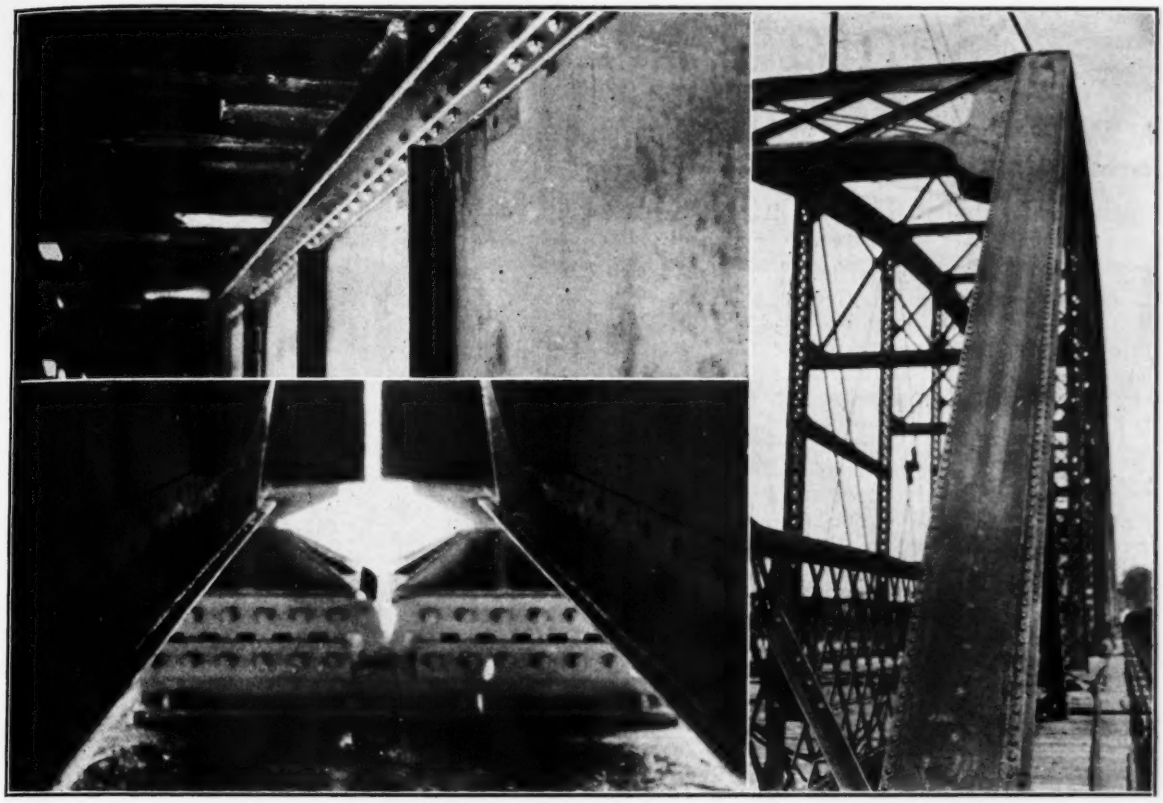
Substantially, all other reinforcing of the bridge consisted of cover plates which were secured in place by electric welding. This included 20-in. by ½-in. plates on the end posts and top chords of the two 330-ft. spans, a 10-in. by $\frac{9}{16}$-in. cover plate for the top flange and a 14-in. by ⅜-in. cover plate for the bottom flange of the floor beams and a 14-in. by ⅝-in. cover plate for the bottom flanges of the stringers. The use of cover plates on the top flanges of the stringers was avoided because this would have made it necessary to remove the decking while the work was in progress.

punched and reamed in these plates at a spacing of 12 in. center to center.

The surfaces of the old members were carefully cleaned of rust and paint before applying the new plates, which were carefully clamped in position before commencing the welding. Three-eighth inch bead welds were made, using welding material having a tensile strength of 50,000 to 60,000 lb. per sq. in. The welds were fused deeply into the base metal. Tests of field welds all resulted in failure outside of the welds.

No Delays to Traffic

The welding was done without interruption to train service, but was discontinued while trains were crossing the bridge. To insure that the new material would be subjected to live load stress, the plates were welded at each end first. That this proved



Examples of the Reinforcing Work—Above, One of the New Flange Angles on the Stringers—Below, New Cover Plates Welded to the Bottom Flanges of End Floor Beams—At the Right, Reinforcing Plate Welded to the End Post Cover Plate Between the Two Lines of Rivets

effective was clearly shown, for in the case of the plates on compression chords or flanges the shortening of the members under live load caused the plates on which the welding had not been completed to buckle within the limits of the unattached portion.

Interesting Experience with Welders

As this was the first work of its kind, few welders were available who were accustomed to working on bridges. Consequently, a considerably greater number of welders were employed for various lengths of service than would normally be the case. Experience also showed that there was a considerable difference in the ability of the welders when employed under the conditions imposed on the bridge. For example, one man who had proved unusually expert under shop conditions, was entirely unsuccessful on this work, primarily because of inability to accustom himself to working in high places and on work that was subject to vibration. However, some of the welders proved especially proficient and completed from 80 to 200 ft. of welds per day, depending upon how continuously they could be employed under existing circumstances. An average of 20 men were engaged on the work, which was started on February 25 and completed on April 28. Four welding machines were used, of which two were 350-400 amp. capacity, alternating current welding machines made by the Electric Arc Cutting & Welding Company, while the other two were single operator direct-current arc welding outfits made by the Westinghouse Electric & Manufacturing Company. Current was available at the bridge site at 60-cycle, 3-phase, 220-volts. The weight of the new structural steel installed is as follows:

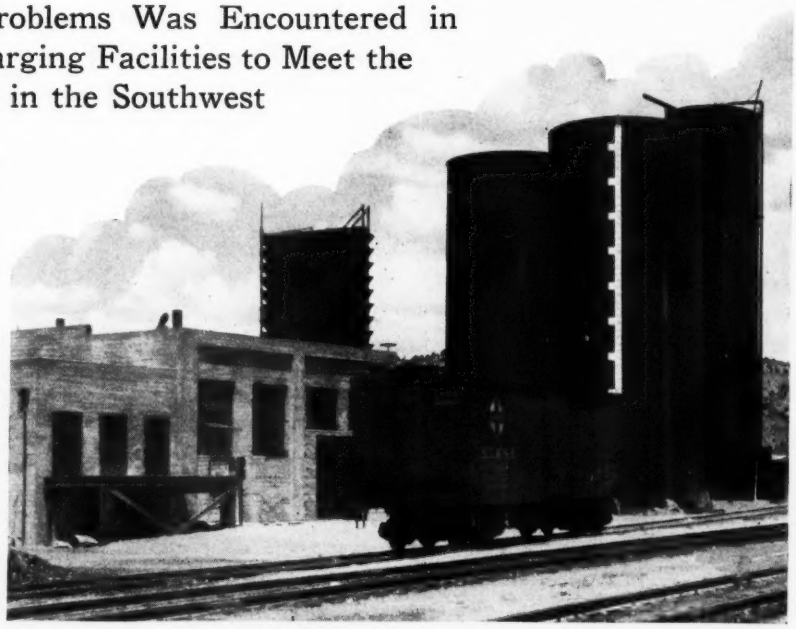
Cover plates all welded in place	104,340 lb.
Flange angles riveted in place	82,728 lb.
Loop rods	24,275 lb.
Miscellaneous parts	13,443 lb.
Total	224,786 lb.

About 7,500 lin. ft. of weld was made for which 1,950 lb. of welding steel was used. The work was done under the direction of C. G. Delo, chief engineer, and W. R. Roof, bridge engineer of the Chicago Great Western. The American Bridge Company developed detailed plans and methods for carrying out the work and supplied all new material and installed it on the structure, Otto Schultz, being foreman for the American Bridge Company, in charge at the bridge.

The Beach at Moclips, Wash., the Extreme West End of the Northern Pacific

Santa Fe Develops Water

A Wide Variety of Problems Was Encountered in Rebuilding and Enlarging Facilities to Meet the Needs of Traffic in the Southwest



IN A DESERT country the development of locomotive water supplies presents a major problem to the water service departments of the railways. The sparse vegetation, the limited annual rainfall, the occasional torrential rains followed by a quick runoff, the normally dry water courses, the ease with which desert soils are eroded, the high alkali content of the soils and the excessive evaporation during the summer season combine to produce conditions which are not met in the more favored sections of the country.

Between Albuquerque, N. M., and San Bernardino, Cal., 832 miles, the Coast lines of the Atchison, Topeka & Santa Fe pass through a region which ranges from semi-arid to absolute desert. For much of this distance, the railway is located on a high mesa which has no streams of consequence and nearly all the water courses that do exist are dry most of the year. Most of the precipitation comes in the winter months or occurs in the form of torrential rains over a limited area during the summer. Lack of vegetation and the absence of trees, as well as the broken character of the country for much of the mileage in this territory, result in a quick runoff, so that little of the water which falls in the form of rain or snow percolates into the sub-soil.

As a result of these conditions, there are only a few places where impounded supplies are practical or where water can be secured from shallow wells. In some instances, where dams have been built to impound the runoff from the winter precipitation, there has been no rainfall or snow over the drainage area for several consecutive years, so that when the reservoirs are drained they remain empty. Again, at other points the excessive evaporation during the summer months has caused such a high concentration of the alkali salts as to make the untreated water wholly unfit for boiler use and, eventually, the concentration may become so great as to make it impractical to soften the water, so that its use will be unsatisfactory. Furthermore, because of the ease with which desert soils erode at some points reservoirs become filled with sediment brought in by the muddy streams which usually carry water only during flood stages. This, however, is not true along the Santa Fe, because reservoirs 25 years old on that line have little sediment.

On the Santa Fe these difficulties have been complicated by the fact that increasing traffic over a period of years has created a constantly growing demand on the water stations in this territory. In many cases, both the existing supplies and the pumping equipment, which only a short time ago were believed to be adequate for some years to come, have become insufficient to meet the present demand and it has become necessary to remodel and enlarge the pumping equipment as well as to secure additional water.

The Freight Traffic Has Doubled

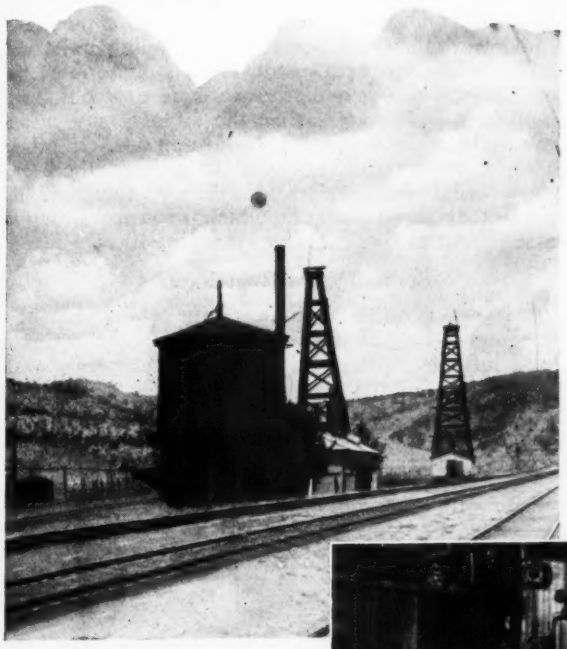
The freight traffic on the Coast lines of the Santa Fe has doubled in the past five years and is still increasing. While the rate of increase in the passenger business has not been so great, relatively it has been large. Six transcontinental passenger trains are scheduled in each direction daily, while during the winter tourist season, the limited trains frequently operate in from two to five sections.

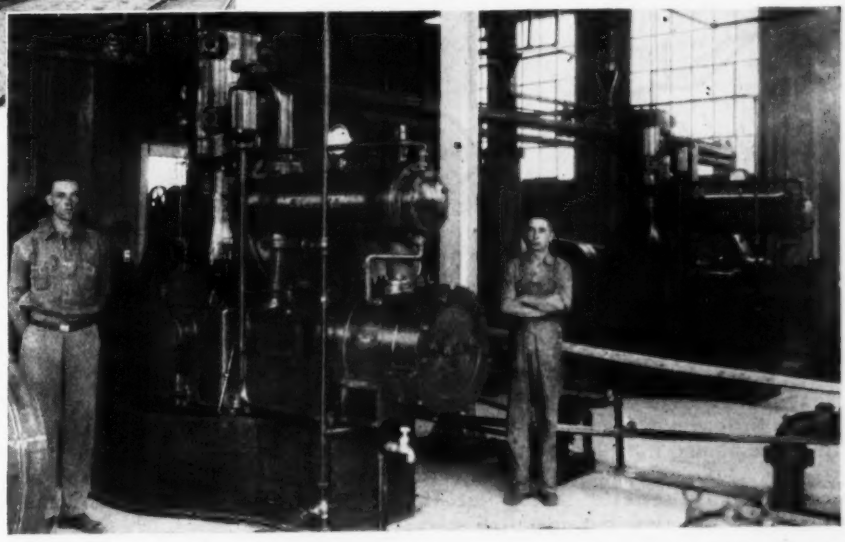
This is in marked contrast with the traffic 30 years ago when the one limited transcontinental train that was operated ran once a week, while the remainder of the transcontinental passenger service consisted of one train each way a day. At that time the freight traffic was in proportion. Local freights ran regularly and one through freight train was scheduled each way daily, while additional trains were run only as the business demanded.

Because surface supplies are not available except at one or two points and because the water from shallow wells, even in the few instances where a sufficient amount can be obtained, generally is not satisfactory for boiler use, the railway has found it necessary to obtain most of its supplies from deep wells or to haul the water from points of sufficient supply to others where no water or only a limited amount can be secured.

Originally, all of the water stations west of Albuquerque were steam operated. As long as 25 years ago there were a few air lift installations. At that time, however, the art of air lift pumping had not reached its present development and these stations were not as dependable as the service de-

Supplies In The Desert





Above—The Water Service Facilities at Peach Springs, Ariz. Water Tank and Wells at the Right and the Treating Plant at the Left.

At the Right—Interior of the Pump House at Peach Springs, Ariz., Showing the Air Compressors Which Serve the Air Lift Pumps.

manded, while the efficiencies of the plants were low. For these reasons, some of the air lift equipment was discarded and steam driven deep well pumps were substituted, while the remainder of these earlier air lifts were later replaced with those of more modern type. The excessive lifts, ranging up to 800 ft., and the fact that the wells contain considerable sand resulted in high maintenance costs and rather unsatisfactory pumping conditions where the deep well pumps were installed.

Haul Coal Long Distances

During and preceding this period it was necessary to haul coal long distances to supply these steam operated plants, so that the cost of the fuel added to the high cost of maintenance made the water supply of this territory quite expensive when compared with other sections of the road. Later, the development of the gasoline engine furnished a substitute for steam operation and many of the pumping stations were equipped with this type of power unit which was connected to the deep well pumps by means of gears and walking beams. In the last decade the price of gasoline has advanced so that its relative economy as compared to steam has been greatly reduced, especially where fuel oil is used for steam generation. However, the development of the Diesel and semi-Diesel engine made available a more practical and economical power unit for water service requirements and on the Santa Fe lines west of Albuquerque these engines have displaced most of the remaining steam plants and many of the gasoline engine installations.

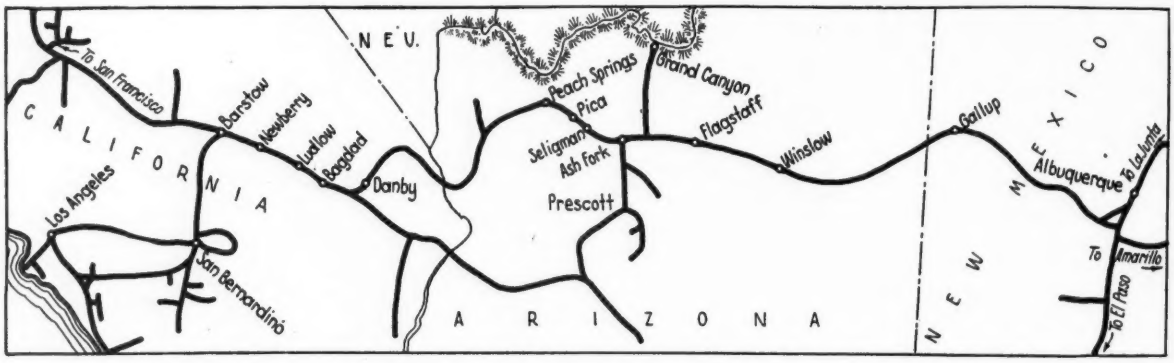
Remodeling of Plants

The efforts to modernize the water stations on the Coast lines began in 1916. From that date to 1921 the rapidly increasing traffic made it imperative that more water be secured for locomotive use and during this period efforts were concentrated on developing new supplies or increasing those already in existence, so that little attention was given to the question of storage. By 1921 sufficient water had been secured so that attention could be given to the other features of the water stations and a program for increasing the storage capacity of the service tanks was arranged. However, for the last 25 years, steel tanks, 24 ft. in diameter, ranging in height up to 60 ft. have been standard for new installations and all of the wooden tanks on the main line have now been replaced. Some of the branch line stations are similarly equipped although a number of wooden tanks remain, but it is expected that these will be replaced as rapidly as conditions permit. Recently, the railway has been installing additional service tanks, 48 ft. in diameter, and 45 ft. to 65 ft. high, at some of the more important water stations on the main line.

Because of the difficulty in obtaining water in the desert, the railway has been compelled to develop domestic supplies also for the use of its employees at many points and, in a few instances, where the railway controls the only available supply, it also furnishes water to the municipalities. For these domestic and municipal supplies steel tanks on

towers are used with capacities varying from 10,000 gal. to 100,000 gal.

At several important water stations there is no possible supply and here the only alternative is to haul the water from stations where the supply is sufficient to permit this being done. For instance, at Ludlow and Bagdad in the Mojave desert in California, no supply of any character has been found and an average of 500,000 gal. is hauled daily from Newberry, Cal., where an ample supply is obtained from the underground flow of the Mojave river not far from the point where it disappears in the desert, to these two points, 35 and 54 miles, respectively. At Del Rio, Ariz., on the Prescott line, there is an ample supply which is obtained from springs, and water to the amount of 1,000,000 gal. a day has been hauled from this station to Seligman and Ash Fork, 62 and 34 miles, respectively. Ash Fork is one of the few water stations which depends on an impounded supply but there have been instances when almost no precipitation occurred over the drainage area which supplies the reservoir, either in the form of rain or snow, for three consecutive years, so that the supply has failed completely for



Map Showing a Part of the Lines of the Santa Fe in California, Arizona and New Mexico

long periods. All of the water used at Grand Canyon for both locomotive purposes and domestic supplies must be hauled from Flagstaff, 97 miles, at very high cost. A possible supply of water at the canyon comes from a series of springs situated about 3,000 ft. below the rim, but installation costs would be very expensive and pumping against this head would be difficult.

Much Remains to Be Done

While practically all of the water stations on the main lines and many of those on the branches of the Coast lines have already been remodeled or enlarged, the constantly increasing traffic is creating new demands and much remains to be done before the water service department is assured it has water supplies and water station equipment to meet every contingency.

In more favored localities, the water problem is simpler because an ample supply can nearly always be found, so that the important problem is that of minimum first cost and economy of operation. Along the Coast lines of the Santa Fe, on the other hand, the problem is more difficult. Here the question of obtaining adequate and dependable supplies is the matter of first importance and this not only calls for engineering skill of a high order but requires long experience and a thorough knowledge of the country, as well as of the specific problems of water supply development. Insufficient knowledge of all the factors necessary to be considered may mean total failure or at best an insufficient supply of water.

In some cases, even at present, new supplies must be obtained; in others, existing supplies must be increased; and in still others, the plants must be remodeled and larger power and pumping units installed, while, frequently, additional storage must be considered. As most of the water is now obtained from deep wells, increasing the supply may mean new wells or the deepening of those in use. In other cases, it means drilling wells at points where no development now exists or the development of supplies at distant places which must be brought to the point of use through long pipe lines.

Some Typical Installations

It is not possible to indicate in detail what has been done at all of the water stations on the Coast lines, but descriptions of a few typical plants will give an idea of the problems the water service department has been required to meet.

The supply at Danby, Cal., is obtained partly from springs and partly from three wells which reach depths of 630 ft., 898 ft. and 983 ft., respectively. The old plant was steam operated but the steam equipment was recently replaced by two 180-hp. Fairbanks Morse type Y full Diesel engines which are short-belt connected to two Ingersoll-Rand air compressors and also to two centrifugal pumps which rehandle the water from a central sump to the service tank.

The first well has now been abandoned and a fourth well is being drilled. Before the Diesel engines were installed the water was pumped from this first well by means of a steam-driven deep well pump, although well No. 2 had been pumped with an old style air lift for many years. The second and third wells are now equipped with modern air lifts and as the water reaches the surface it flows into a central sump from which it is rehandled to the service tanks by means of the centrifugal pumps. The supply from the wells amounts to 250 gal. per minute and this is supplemented by a gravity supply of about 500 gal. per hour from Cane Springs which is brought to the sump through a six-inch cast iron pipe about five miles long.

At Hackberry, Ariz., different conditions were encountered. Here a dug well, 75 ft. deep, was sunk to rock and curbed with reinforced concrete pipe, 7 ft. 6 in. in diameter. The excavation was then carried about 25 ft. into the seamed granite which underlays the surface strata, at which point a good

supply of water was obtained. Since the well has been put into operation, a flow of about 500 g.p.m. has developed at the surface of the rock, so that at this station an ample supply of water seems assured permanently. This well is equipped with two pumps, one a vertical steam-driven centrifugal deep well pump operating at 1750 r.p.m. and the other a similar pump driven by a 3400 r.p.m. steam-turbine through a DeLaval worm gear which reduces the speed to 960 r.p.m., as well as changes the direction of the drive.

A Recently Equipped Station

One of the recently equipped water stations is at Peach Springs, Ariz. The wells at this station were originally 924 ft., 1,003 ft. and 851 ft. deep, but due to casing failure and other causes are now 614 ft., 730 ft. and 851 ft. deep, while the static head, or normal level of the water below the surface is 364 ft., 396 ft. and 290 ft., respectively. The wells start at the surface with diameters of 16 in. which later are reduced to the diameters shown below. Stove pipe casing is used for the larger sections and California Diamond BX casing for the smaller sections. The plant is equipped with two Sullivan 14 in. by 8¾ in. by 10 in. WJ-3 angle compound air compressors, each of which is driven by a short belt connection to a Fairbanks Morse type Y, 75 hp., semi-Diesel engine. Sullivan air lift pumping equipment is used in each of the wells. The characteristics of the plant are shown in the table:

	Well No. 1	Well No. 3	Well No. 5
Depth, ft.	614	730	851
Diameter, in., at pumping level	13	12½	10
Static level, ft.	364	396	290
Drop, ft.	50	14	141
Elevation, ft. (including friction in discharge line to elevated tank)	22	25	15
Total lift, ft.	436	434	446
Operating submergence, ft.	190	252	194
Total vertical discharge, ft.	626	686	640
Depth of pumps in well, ft.	604	661	625
Air pressure, lb. (without friction)	82	109	84
Friction, lb.	0	1	3
Operating pressure, lb.	82	110	87
Length of eduction pipe in ft. and diameter in in.			
2 in.	475	536	275
2½ in.	129	125	200
3 in.	.....	.....	150

For All Three Wells

Gallons pumped per minute	59
Actual air required, cu. ft.	181
Displacement required, cu. ft.	271
Water hp.	6.55
Operating hp.	45
Efficiency per cent	14.5
Compressor speed, r.p.m.	153

The low efficiency is due to the fact that an air pressure of 110 lb. must be carried for well No. 3, while 82 and 87 lb., respectively, are sufficient for the operation of wells Nos. 1 and 5, the efficiency being based on the power required to operate the compressor. In addition to the above, 2.58 hp. is used to rehandle the water into the storage tank.

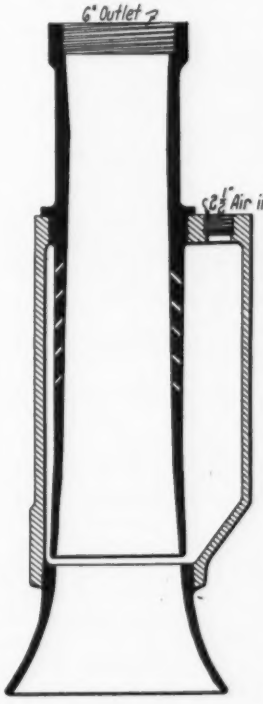
An Example of Deep Pumping

At Pica, Ariz., the wells, also three in number, are deeper, 1,546 ft., 1,634 ft. and 1,788 ft. while the static level of the water is 740 ft. which is the extreme depth encountered on the entire line. Here the air delivery pipe is 1,300 ft. below the surface and the drop averages only 23 ft. during the pumping operation. Because of the great depth, the operating pressure is 235 lb. and the starting pressure 245 lb. The power units consist of two 75 hp. semi-Diesel and one 180 hp. full Diesel engines, all type Y, manufactured by Fairbanks Morse & Co., and one 100 hp. semi-Diesel engine manufactured by the Chicago Pneumatic Tool Company. Three of the air compressors are supplied by the Ingersoll-Rand Company and the other by the Chicago Pneumatic Tool Company. The air lift equipment at this station was supplied by F. J. Kimball Company, Los Angeles, and by the Indiana Air Pump Company.

The first two wells have been in operation for a number of years, but the increasing demands on the water station required an additional supply, so that the deeper well was drilled recently. The flow from the older wells averages 35 to 50 g.p.m., while the new well delivers 75 g.p.m. Because of the great depth from which the pumping is done, 4.5 cu. ft. of air is required per gallon of water pumped. At this station, as at Peach Springs, the water is treated, and chemical reagents are handled by a small motor-driven pump which takes current from the signal line.

An Impounded Supply Supplemented by Springs

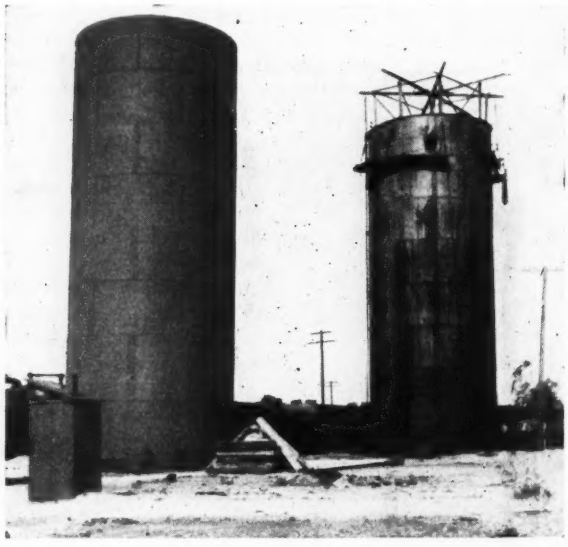
Winslow, Ariz., is one of the few water stations where an impounded supply is feasible. The reservoir is located about 8½ miles from the water tank at Winslow. The water is impounded by a rock filled dam, 12 ft. high, thrown across the channel of Clear Creek at a point where it flows through a deep rock gorge. The reservoir is filled by the winter rains and by the flow which results from heavy summer storms, but this supply is supplemented by perennial springs which discharge a large volume of water. The water is pumped to an auxiliary reservoir by two steam-driven piston pumps and one deep well gasoline engine-driven turbine pump which is capable of operating against a head of 230 ft. The pumps are set in a pit, 30 ft. in diameter, sunk 80 ft. through solid rock to a point several feet below the normal level of the reservoir, so that the extreme suction lift, when the reservoir is low, is 5 ft.



Cross Section of a 6-In. Air Lift Pump

The pumping station is located 1½ miles above the dam and the suction lines extend 75 ft. from the pumps to the reservoir. The reason for the deep pit in which the pumps are set is that during flood stages the creek has a maximum rise of 60 ft. During flood stages the water contains such quantities of sand and volcanic ash that it is necessary to renew the pump valves every 30 minutes and the pump packing every 12 hours, whereas under normal conditions the packing is renewed only once every six months.

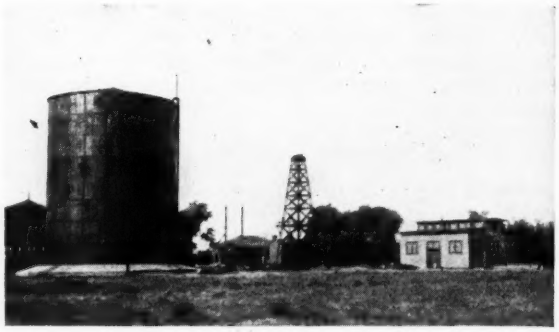
Winslow is a division point and is one of the places where the railway is compelled to supply the municipality with water. While there is no contamination of the water supply by sewage, the water for the city is chlorinated just before it reaches the separate distributing tank for the municipal supply. The railway owns several hundred acres of land not used for railway purposes a short distance west of town, and in order to make this land available for cultivation, it is irrigated with water from the reservoir. The water for the city and for locomotive use is raised by the pumps to an auxiliary reservoir having a capacity of 5,000,000 gal. and then passes by gravity through three 8 ft. by 20 ft. Roberts filters which are situated at the top of the bluff not far from the pump pit. The supply lines consist of two parallel lines of 8 in. cast iron pipe, 7 miles long, which extend from the filters and join into a 12 in. cast iron pipe which extends 1½ miles further to the point of delivery. The maximum demand on these lines is 1,100 g.p.m., while the gravity flow does not exceed 650 g.p.m., so that booster pumps are necessary for frequent use between the filters



Erecting a 24-Ft. by 60-Ft. Tank at Bagdad, Cal.

and the tanks. The water for irrigation purposes is conveyed by gravity through 2,500 ft. of 36 in. concrete pipe which discharges into the main irrigation ditch.

It is planned to remodel this plant completely, both for the purpose of making it more effective and to reduce the cost of operation. Under the new arrangement a sump will be constructed 1½ miles west of the service tanks. A 30-inch line of concrete pipe, 2,000 ft. long, will tap the irrigation ditch near the point where it crosses the railway to divert the water for locomotives use to the sump, where it will be rehandled to the service tank by two 1400 g.p.m. motor-driven Gould centrifugal pumps. The chlorination equipment will be removed from its present location near the municipal tank to a point near the filters, so that chlorination will take place before the water has passed the filters. The city supply will be brought in as at present but a section of the discharge lines will be relaid to permit sufficient gravity flow and thereby eliminate the necessity for the booster pumps. The steam-driven pumps at the reservoir may later be replaced by power operated pumps. The present plant has no standby units and requires continuous operation through the 24-hour period. Under the new arrangement there will be ample storage and duplicate pumping equip-

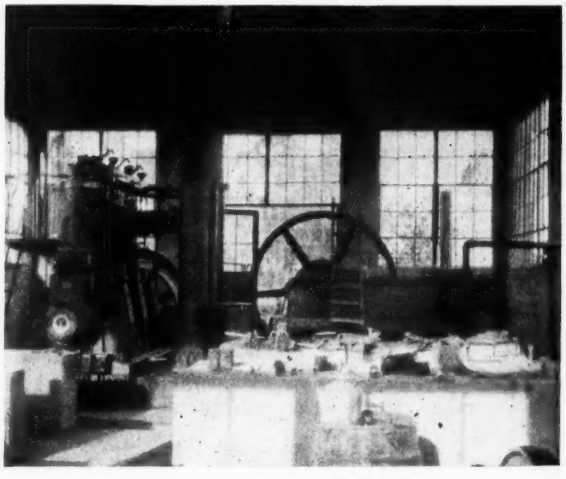


Tank 48 Ft. by 60 Ft. at Newberry, Cal.

ment of sufficient capacity, so that all the pumping necessary can be done in two 8-hour shifts, thereby reducting the pumping force from seven men to three men.

Gallup Has Deepest Wells

The deepest wells on the Coast lines are at Gallup, N. M. At this station there are four wells which reach depths of 1,350 ft., 2,100 ft., 2,300 ft. and 2,300 ft., respectively, although the static level, 45 ft., is higher than at Pica. The starting submergence, however, is greater, but the operating submergence is substantially the same. At this station the air for pumping is delivered at two levels, 800 ft. and 1,080 ft. When it is desired to start pumping, the water is delivered to the nozzle at the upper level by opening the valve in the air line to the nozzle and the water in the well is drawn down to about 400 ft. below the surface. The valve to the upper level is then closed quickly which forces it to go by a separate line to the lower level. For a



Installing Diesel Engines at Danbury, Cal.

moment the pressure builds up to 325 lb. in this line, but reduces to 240 lb., the normal operating pressure, as the water begins to flow steadily and recedes to a pumping level of 530 ft.

The compressors at this plant are steam-driven.

The air for pumping is taken at 90 to 100 lb. pressure from a 2,500 cu. ft. two stage compressor which is part of the locomotive shop equipment at Gallup. It is then boosted to the high operating and starting pressures by means of a piston valve Ingersoll-Rand air compressor of 1,500 cu. ft. capacity installed in the pump house. An older Laidlow-Dunn-Gordon compressor is used as a standby unit. The maximum consumption of air when all the wells are working to capacity is approximately 1,300 cu. ft. of air per minute. The normal consumption is about 1,000 cu. ft. per minute.

The wells are situated about 400 ft. apart and extend into water bearing sandstone strata. They are delivering 73, 50, 117 and 200 g.p.m., respectively, under continuous pumping, although the first three wells had deliveries of 110, 110, and 220 g.p.m. when first put into operation. The normal monthly consumption of water at this station ranges from 6,000,000 to 9,000,000 gal., so that this supply has a safe margin for some years to come.

The water is not treated because the analysis indicates only 1.6 grains of encrusting solids, although the total solids range from 39 to 49 grains. The water has a strong corrosive action on the eduction pipe in the wells though it does not seem to have any such effect on the locomotive boilers. The company's chemists, so far, have been unable to explain the corrosive action on the pipes in the wells and the absence of similar action on the boilers.

The plants which have been described are typical. Most of the water in this territory comes from deep wells; a limited number of stations receive all or a part of their water from springs in or near the mountains; a few impounded supplies are possible, but because of the conditions mentioned this source is not entirely dependable and, where it is, the handling of the water is attended with difficulty; at other stations haulage is the only solution of the problem. In the development of locomotive water supply in this territory dependability is given first consideration in every case. The question of economy is not ignored, but, in many instances, the whole problem resolves itself into the question of getting water regardless of other considerations.

Water Treatment

The quality of the water varies considerably. Some waters cannot be improved by treatment, while others carry as high as 53 grains of encrusting solids and a maximum total of 90 grains of all solids, though this may vary with the seasons. Some of the supplies are very low in encrusting solids but high in total solids, while in other cases the encrusting solids may be high with a minimum of non-encrusting solids. Taken as a whole, about 75 per cent of the water consumed requires treatment. Many of the wells contain sand and the impounded supplies almost invariably contain volcanic ash also, both of which must be removed before the water is delivered to the locomotives. For deep well pumping the air lift is preferred to the deep well pumps, because it requires practically no maintenance below the ground surface. Moreover, actual tests have shown that the efficiency of the reciprocating deep well pump is frequently low because the sand in the water cuts the cylinders so quickly, in addition to which the constant need of repairs keeps this equipment out of service much of the time and requires the services of expensively outfitted repair gangs. In a few cases, however, where the flow is small, reciprocating deep well pumps are still used and in a few others, where the lift is low, the centrifugal type is in service.

Pumps and Power Units

During the past six years the water service department has been installing the turbine type of centrifugal pump, either belt driven or direct connected to power units, for heads up to 200 ft. The belted pumps of the centrifugal type are all driven by internal combustion engines, usually of the semi-Diesel type. In general, the direct connected turbine pumps are motor-driven, while duplex reciprocating pumps may have motor, internal combustion or steam engine drives. Motors are used up to a maximum capacity of 100 hp. and a number, including the 100 hp. size, are controlled by float switches. At a few stations, where the discharge head is high, power-driven triplex pumps are in service. Organ motors are used at about 30 treating plants for the purpose of proportioning the chemical reagents.

The development of the water supplies on the Coast lines has been made by G. L. Davenport, assistant engineer in charge of water development, under the supervision of R. B. Ball, chief engineer, and under the general direction of W. K. Etter, general manager.

Large Expenditures for Roadway Improvements

THE RAILWAYS of the United States spent $885,086,000 chargeable to capital account for additions and betterments to their properties in 1926, according to complete reports for that year just received by the Bureau of Railway Economics and made public by the American Railway Association. This was an increase of $136,895,000 over similar expenditures in 1925 and an increase of $10,343,000 over 1924. Of this total amount $513,164,000, or 58 per cent, went for improvements to roadway and structures, including additional tracks and ballast, heavier rail, additions to shops and enginehouses, machinery and tools, etc. The amount spent for this purpose in 1926 was greater than for any previous year on record.

During the four years from 1923 to 1926, inclusive, the capital expenditures of the railways aggregated $3,567,170,000. Of this total $1,681,801,000, or 47.1 per cent, was appropriated for the improvement of roadway and structures. The proportion of the total expenditures going to roadway and structures has increased steadily from 36 per cent in 1923 to 44 per cent in 1924, 55 per cent in 1925 and 58 per cent in 1926.

Capital expenditures for additional tracks in 1926 amounted to $166,758,000, an increase of $21,000,000 over 1925. Capital expenditures for heavier rail amounted to $42,184,000, exceeding the corresponding amounts in the three previous years. This was also true of expenditures for additional ballast, which amounted to $16,520,000 during the last year. The capital expenditure for shops and enginehouses, including machinery and tools, during 1926 amounted to $46,882,000, a substantial increase over the two preceding years, but a decrease of $4,300,000 as compared with 1923.

All of the figures given above refer only to capital expenditures to the exclusion of money spent for the repair of the properties and chargeable to operation.

Machines Expedite Rail Laying

Power Rail Layer and Pneumatic Wrenches and Spikers Promote Economy and Speed of Work

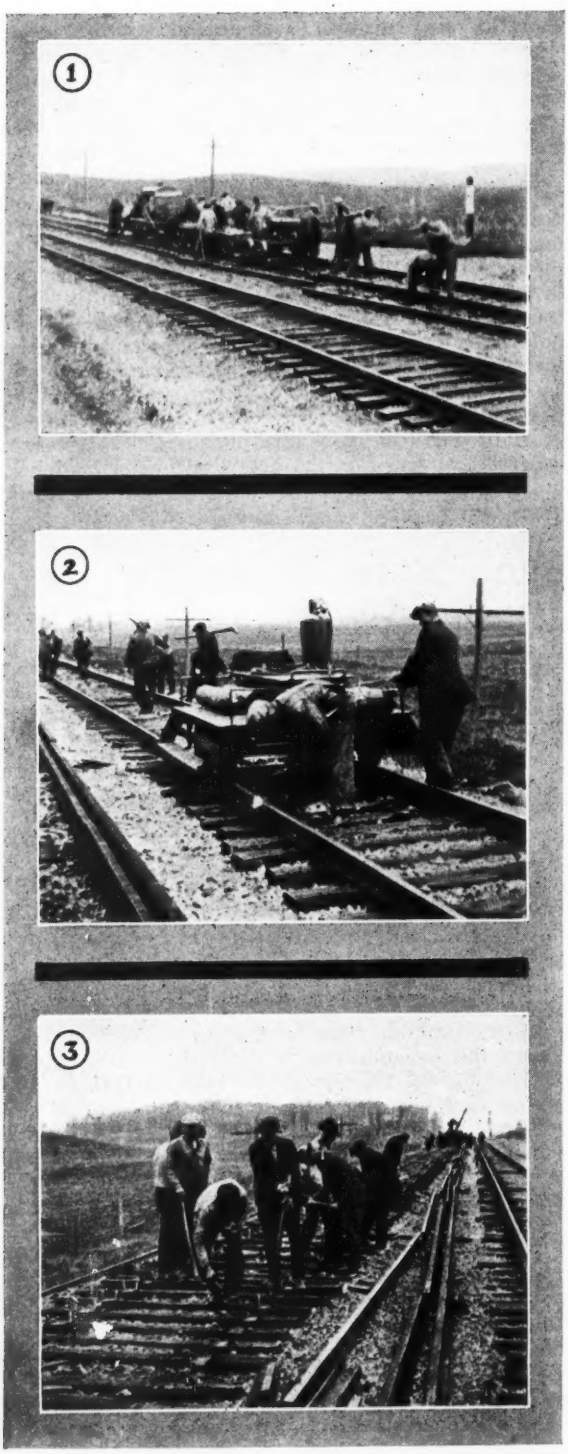
THE Chicago & North Western this year inaugurated the practice of equipping its large rail laying gangs on double track so that not only the removal of the old rail and the setting in of the new could be done by mechanical means but also that the removal of the old nuts and the application of the new ones, as well as the drilling for the bond wires and the driving of the spikes for the new rail could be performed by pneumatic tools. As a result it completed the replacement of 136 track miles of 100-lb. rail with new 110-lb. rail, or approximately 80 per cent of the season's program of 176 track miles, shortly after the first of June, or in slightly more than two months, using two gangs equipped with the necessary machines and adjuncts. Owing to the difference in the width of the bases of the old and new rail it was necessary to pull all the spikes and apply new tie plates on all ties.

This work was done on the main line between Chicago and Council Bluffs, Iowa, 54 miles having been laid in Illinois and 82 miles in Iowa, all in high-speed, heavy-traffic territory. The remainder of the year's allotment consists of relatively short stretches where numerous street crossings, turnouts and other conditions are not favorable to the full use of the mechanical equipment. The rate of progress attained by one of these gangs on work involving the relaying of 22 miles of track between Belle Plaine, Iowa, and Tama is shown for each of the days worked. During this entire period the weather was rainy and unsettled, and more or less time was lost on this account.

Schedule of Rail Laying Progress

Date	No. of Ft. of Track Relaid	Remarks
May 20	5,000	
May 21	8,300	
May 22	.....	Sunday
May 23	6,600	
May 24	9,150	
May 25	11,310	
May 26	8,270	
May 27	.....	No work, rain
May 28	10,700	
May 29	.....	Sunday
May 30	.....	Memorial Day
May 31	10,313	
June 1	12,000	
June 2	12,480	
June 3	10,250	
June 4	11,820	
Total	116,193	
Daily Average	9,683=1.83 miles	

To permit the uninterrupted use of the machines and at the same time to avoid delays to traffic, the track to be relaid is given over to the use of the rail gang during working hours, the regular traffic in both directions being handled over the other track, which is operated as a single-track line. A dispatcher is assigned to the work to handle the train movements on this stretch of single track and careful planning on the part of the division dispatcher avoids



(1). Removing Nuts from the Old Rail with Pneumatic Wrenches

(2). Rusted Bolts Are Burned Off With an Oxy-acetylene Torch

(3). Inserting Tie Plugs and Adzing the Ties

on Chicago & North Western

Replacement of 136 Track Miles of 100-lb. Section with 110-lb. Completed in Two Months

serious delays to trains due to this method of operation. Each day's work, including the bonding of the track for the automatic signals, is completed before the gang quits work so that double-track operation may be carried on during the night with no restrictions. The gangs work 10 hours a day, it having been found that the men prefer this on account of the greater daily pay, while it is also advantageous to the railroad by securing a greater output per day.

Equipment Used

The complement of machinery assigned to the gang consists of three Cullen-Friestedt "steel burro" rail cranes, three Ingersoll-Rand pneumatic-tamper air compressors, with pneumatic wrenches, spikers and bonding drills, and an oxy-acetylene outfit mounted on a push car. A work train follows the gang, loading the old rail and other material and sufficient motor cars with trailers are supplied to haul the men between the boarding cars and the work, the boarding cars being moved from time to time to avoid long travel by the men.

At first glance this array of machinery appears formidable and would seem to indicate a heavy investment for special equipment but an analysis soon discloses that this is more apparent than real, since the compressors used are those assigned to the division for ballast work and as soon as each job of rail laying is completed they are put to work surfacing the track out of face where the rail has been laid. Similarly the other units of equipment are available for other purposes as soon as they are released from the rail laying work.

As has been said above the work carried on this year necessitated the pulling of all spikes and the application of new tie plates to all ties. The rails on both sides were removed and relaid as the work progressed so that the track was completed each night up to the point where the gang quit work. One of the rail cranes was used to remove the old rails and another to set in the new ones, while the third crane was mounted on a flat car in the work train to load the old rail. Of the three compressors, two four-tamper units were used to operate the pneumatic wrenches removing the old nuts and running up the new ones, respectively, and an eight-tamper unit was used to operate the pneumatic spike drivers.

Sequence of the Work

The make-up of the force and the sequence of the various steps may be shown by a typical day's work of the gang which recently completed the laying of new rail in Iowa. The total number of men on the day cited was 185, an extra gang of 120 men being assigned to the work, supplemented by section gangs. The entire work was in charge of a general foreman, with three assistant foremen.

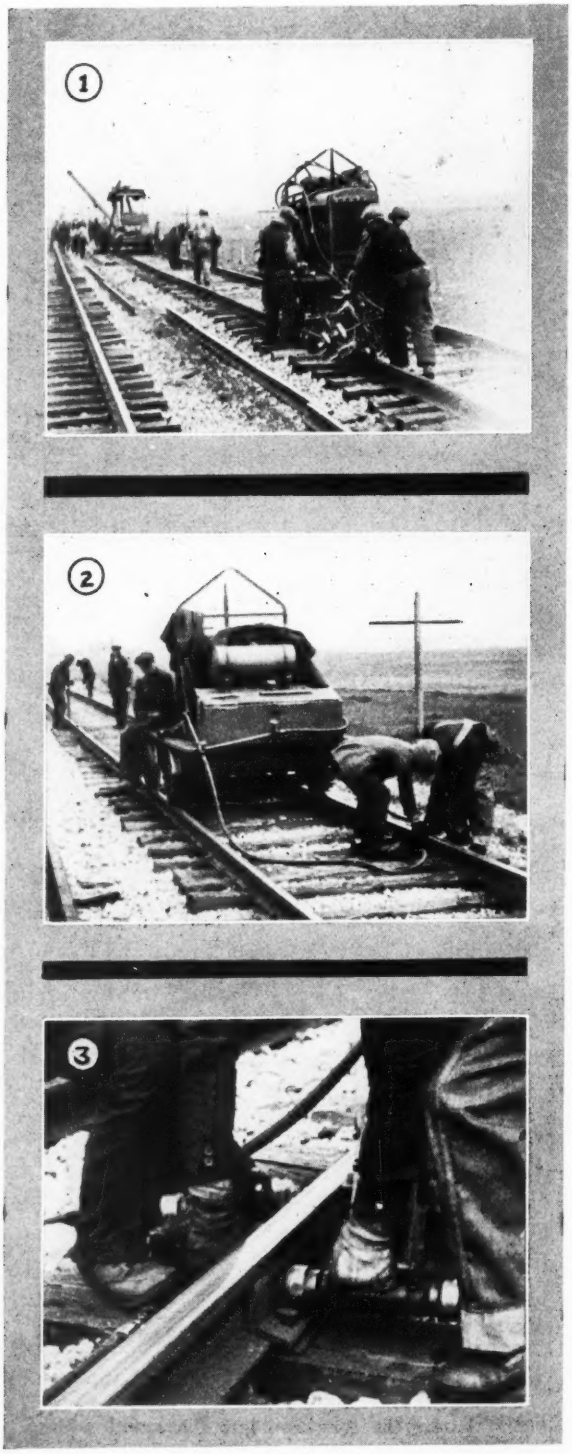
In the lead a gang of 48 men pulled the spikes along the old rail, removed the old anti-creepers

(1). Setting the New Rail into Place with a Gasoline Rail Crane

(2). Behind the Crane Setting in the New Rail—Crane Removing Old Rail in the Distance

(3). A Close-up of the Rail Crane

and loosened the nuts on the bolts so that they might be removed readily by the pneumatic wrenches. In case the bolts were rusted so that they were hard to start no time was wasted on them, but they were left to be burned off by the oxy-acetylene torch outfit which followed closely behind the compressor operating the pneumatic wrenches. Since the nuts were staggered alternately on the inside and outside of the rail two wrenches can operate simultaneously on each joint without interfering with each other. Two men knocked out the old bolts and removed the old angle bars, and were followed by a rail crane, backing up, which picked up the old rails and placed them in the inter-track space to be loaded later by the work train.



(1). Pneumatic Drills Are Used for Bonding
(2). Running Up the Nuts on the New Rail With Pneumatic Wrenches
(3). A Close-up of the Pneumatic Wrenches

After the rails were removed a gang of 32 men adzed the ties, distributed and drove tie plugs in the old spike holes and placed the new tie plates on the ties in readiness for the rail crane, which set in the new rail. This crane was followed by a gang of 12 men who placed the new angle bars on the rails, inserted the bolts and started the nuts, four men distributing bolts, spikes, etc., from a push car. Following this gang was a compressor operating the pneumatic wrenches which ran up the nuts to a point where only two or three turns were necessary to tighten them with hand wrenches. Three pneumatic bonding drills were operated behind this compressor by men from the signal department who applied the rail bonds, so that the bonding was completed as the rail was laid.

Rail Was Gaged by Hand Spikers

After the rail was bolted a gang of 30 men gaged the rail, spiking it at intervals to hold the gage and placed the spikes in the remaining ties to be driven by the pneumatic spikers. The spikes were driven into the ties only enough to hold them firmly in a vertical position, short handled hammers being used for this purpose and care being taken to start them straight so that they might be driven properly by the spikers. Two men in this gang with hand wrenches tightened the nuts run up by the pneumatic wrenches.

As this work progressed it was followed by an eight-tamper compressor operating two pneumatic spikers, one to each rail, which drove the spikes at the rate of from 1½ to 2 min. to the rail length. On the work under consideration this compressor was not self-propelling but was pushed by a Casey Jones motor car. The spikes were driven home snugly. Any which had not been started properly or which had been knocked from the vertical before being reached and which could not be straightened easily by the operators of the spikers were left to be driven by hand by a gang of 12 men who applied the anti-creepers, of which 8 are used to the rail, and did any other work which might be found necessary to make a finished job. Bringing up the rear was a work train with 14 men, picking up the old rail and other material, which was sorted as it was loaded.

A typical make-up of the gang is shown in detail in the tabulation shown in an adjoining column. The distribution of the gang varies somewhat from time to time, depending on the progress of the various parts of the work so that the different tasks might be co-ordinated to insure uniform advancement of the work as a whole.

Advantages Gained

The adoption of this method has reduced the cost of laying new rail materially below that under the methods formerly employed. While this saving is of prime importance other valuable advantages are also gained, among which may be cited the completion of the laying of the new rail early in the season, which also advances the time in which the program for laying relay rail may be completed, the

shortening of the period of dislocation of section work on the territory where the new rail is being laid and a marked decrease in the labor turnover, together with an improvement in the morale of the gangs.

The increased use of machines for the work has eliminated much of the drudgery inevitable with hand operation and as a consequence the men are easier to retain. "Hobo" labor drawn from Chicago is used and the men are housed in boarding cars furnished by the railroad company and operated by the Western Boarding & Supply Company. No attempt is made to drive the men to secure a large output but they are kept informed as to the rate of progress and their sporting instincts are aroused to secure as large a mileage as is consistent with the quality demanded.

Typical Makeup of Rail-Laying Gang

No. of men	Kind of work
1	General foreman
3	Assistant foremen
2	Water boys
42	Pulling spikes
4	Loosening bolts
2	Removing anti-creepers
1	Air compressor operator
2	Operating pneumatic wrenches, taking off nuts
2	Oxy-acetylene torch, operator and helper
2	Removing old angle bars
1	Rail crane operator, removing old rail
3	Handling rail at crane
20	Adzing
1	Broom man
11	Distributing and driving tie plugs, and placing tie plates
1	Rail crane operator, setting in new rail
3	Handling rail at crane
2	Handling rail shims
8	Applying new angle bars and starting nuts
6	Distributing spikes, bolts, etc., from push car
1	Air compressor operator
2	Operating pneumatic wrenches, running up nuts
3	Signal department men, drilling and applying bond wires
2	Tightening nuts with hand wrenches
30	Gaging and setting spikes
1	Air compressor operator
2	Operating pneumatic spikers
8	Applying anti-creepers
4	Redriving bent spikes and miscellaneous work
1	Rail crane operator with work train
14	With work train, picking up old material
185	

After the laying of any particular stretch of rail has been completed it is surfaced out of face by an extra gang using pneumatic tampers, the necessary tie renewals being made at the same time. The gang which recently completed its rail laying between Belle Plaine and Tama was equipped as a ballasting gang and put to work surfacing the track it had just laid between those points.

Rail Laying Is Programmed for the Season

The program for the year for both new and relay rail is made in the office of the engineer of maintenance as soon as the allotment has been decided upon. The best of the released rail is selected for relaying on the more important secondary lines after the ends are sawed off, new angle bars being furnished before the rail is relaid. The new rail is distributed by work train in advance of the beginning of the work and after that all operations are done by the rail laying gang, including the picking up of the old material, as has been described. The roadmaster of the division on which the rail is laid is in charge of the work while the gang is on his territory and devotes much of his time to its general supervision.

The new rail laid this year is of the A. R. E. A. 110-lb. section for which a new design of angle bar has been adopted, in which the angle terminates just clear of the edge of the base of the rail. The ties

(1). One Man Operates Each Pneumatic Spiker
(2). Tightening the Bolts With Hand Wrenches
(3). Loading the Old Rail With a Rail Crane Mounted on a Flat Car

are not spaced for the joints of the new rail and all anchoring of the rail is done by anti-creepers, the Unit anti-creeper, manufactured by the Creepcheck Company, being used.

The organization of the gangs made necessary by the use of the various mechanical devices was worked out by C. T. Dike, engineer maintenance of the Chicago & North Western, to whom, and to C. Kratoska, roadmaster, with headquarters at Ames, Iowa, we are indebted for information concerning the work.

How a Foreman Can Help to Reduce Accidents*

By Charles Gibson
Section Foreman, St. Louis Southwestern, Brinkley, Ark.

A DISCUSSION of the slogan, "Safety First," as you know, covers a large field, involving many important details. I shall only attempt to cover that phase of the subject which affects my position, as one of the many specialists necessary for the proper supervision and maintenance of a trunk line railroad, and make only such remarks as are pertinent to the subject in hand, as a practical track man, striving to do his bit, sees it. "Safety first" is not only a slogan; it requires thinking about the safety of the men working under your direction, as well as yourself, and protecting the job.

We should always keep our eyes open, for apparent dangers are always obvious. We ordinarily avoid such emergencies as these, but it is the little things to which we sometimes give little thought that oftentimes harbor insidious dangers. Sometimes we are prone to run large risks, unwittingly, because we do not analyze the task in hand, and thoroughly consider the best way to handle the matter. We must do those things in order to effect an improvement over our showing in the number of accidents which happen on this division as statistics compiled in the office of the superintendent of safety point an accusing finger at many of us.

Let us not assume any unnecessary risks. The safe way is the right way and there is only one way that is right. Let's do the thing that way to the best of our ability, even if the thinking which this "only" way involves gives us a splitting headache. The head will soon grow accustomed to its new task and it will not increase the size of the hat we wear, either. The company has posted "Safety Bulletins" in a number of conspicuous places. I wonder if we read them carefully? I wonder if we study and meditate upon them as is the intention of the institution? They are so easy to understand and practicable to follow.

Avoid Taking Chances

Sometimes we feel that time and money are saved by taking a risk. We continue to do it, make a good showing, win praise, commendation, and possibly promotion. Then, by way of following an apparently successful example, another ambitious young fellow, associated with us runs the same risk in identically the same way and comes to grief. So we should not employ dangerous ways of doing things, for to do so establishes a dangerous precedent for another less skillful than ourselves to follow and fail in the ultimate objective.

Do you try to do your work in this safe way or right way? Are you thinking of the unnecessary risks which unwittingly you might cause your men to take? These rules apply to the daily routine of work. Handling motor cars and hand cars on and off track, with every man putting forth only his own portion of the effort. Do you obey the rules in regard to the operation of motor cars, both day and night, going around sharp curves, and keep a lookout for obstacles which might cause a wreck? Do you watch road crossings carefully? Do you supervise the seating of your men, and the placing of the track tools, with a view to their best arrangement from the standpoint of safety? Do you obey the rules in regard to operating your car at a safe rate of speed? If you are guilty of not considering these safety measures, resolve now to bear them in mind, and to follow instructions to the letter.

In pulling a spike with a clawbar, don't grasp the bar too near the end, as the bar might slip and a crushed finger result from coming in contact with the rail. Keep a firm grip on the bar or it may fall and damage a foot. When using a track wrench, don't stand in front of the wrench, as it might slip and hit you in the face. When spiking do not hold the fingers between the rail and spike, for the maul may glance and result in a mashed finger. Do not place jacks inside the rail as a swiftly approaching train might surprise you, and in attempting to remove the jack, you run the risk of getting hit by the train. Don't make a nipper bar of your shovel. Take the best of care of your track level, as much depends upon this tool remaining in the best of condition. Do not beat your track liner into place under the rail but use a shovel to dig a pocket for the liner. The results are far better.

Use Care in Handling Material

When the job is done, place your tools on the car so that they will not fall off. The water keg and jacks should be loaded on the rear of the motor car. The men should be evenly distributed over the car and not be permitted to sit on loose tools or ride on the push car. When hauling ties, place them across the car and not lengthwise. Load them evenly to insure proper distribution of weight. When loading rails or other heavy beam material, be sure the weight is evenly distributed among the men when lifting. Keep the load well balanced. Require your men to use the same tool from day to day. Make each responsible for his tools and confine himself to the use of his own tools. When working on the track, the men should be so distributed and spaced as not to be in one another's way.

We must plan this battle for safety first, very earnestly and carefully. Unless we study and educate ourselves toward a better record of achievement along the lines under discussion, we will remain in the same old rut, and the numerous accidents of the past few months will continue to pile up. Let us not attribute these accidents to "hard luck." What an overworked excuse! "Hard luck" is another expression for "bad management."

Let us firmly resolve to talk, preach and practice "Safety First." We'll inspect those motor cars and equipment for possible defects, bearing in mind the fact that all men make mistakes. We'll get rid of defective tools and discard them for safe ones. We will not accept a motor car with bent or sprung axles, or tolerate the use of one in such shape now on the job, any longer. Motor cars and tools altogether are not worth one life and a slight injury will buy any one of them.

*Abstracted from a paper presented at the sixth annual meeting of the Maintenance of Way and Sanitary Engineering departments of the St. Louis Southwestern at Paragould, Ark., on March 24, 1927.

Axle Loads, the Track Structure and Rail Failures?

Experiences of Pittsburgh & Lake Erie Indicate That an Intimate Relation Exists Between These Three Factors

AN interesting and informative study of rail failures has been made by the Pittsburgh & Lake Erie which indicates clearly that there is an intimate relation between the strength and stiffness of the track structure and the loads imposed upon it. The essence of this study, which extends back to about 1915, is illustrated in the chart which shows the relation that has existed on that road between the weight of the track rail and that of the rolling stock, and, also, the relation of these two factors to rail failures.

History of the Rail Failures

From 1910 to 1916 the track on the Pittsburgh & Lake Erie included several sections of rail, the heaviest of which was the 100-lb. A. R. A.-B. section which was standard for main line tracks. During this same period the heaviest power used on the road was the consolidation or 2-8-0 type with axle loads of about 42,500 lb. With this track and motive power, the number of rail failures ranged from about 170 to 220 yearly until 1915, when, owing to the gradual decrease in the mileage of light rail, the number of failures dropped to about 85. With the continued increase in the amount of 100-lb. A. R. A.-B rail in service to about 72,000 tons, or 100 per cent of the total in main tracks, and with little change in the rolling stock, the number of rail failures declined still further until 1918, when it reached a minimum of about 65.

Apparently, within this latter period from 1915 to 1918, a relation existed between the weight of the rail in the track and the weight of the rolling stock which was conducive to the development of few rail failures, for when this relation was altered materially during the next three years by the rapid increase in the weight of cars and power, while the track structure remained about the same, the number of failures increased rapidly. In analyzing this situation it is noted that during 1916 the Pittsburgh & Lake Erie began to introduce locomotives of the Mikado, 2-8-2, type with axle loads ranging from 60,000 to 75,000 lb., and almost concurrently began to purchase cars of 70-ton capacity with loaded axle loads of about 51,000 lb. Until 1918, when there were only about 35 of the heavier locomotives and about 2,000 of the larger cars in service, their effect upon the rail was not appreciable, but when in 1919 the number of these locomotives had increased to 65 and the number of 70-ton cars to 2,500, the number of rail failures immediately increased from the earlier minimum of 65 to about 200. Even more striking was the increase in the rail failures which occurred during the following year under practically the same conditions of track and loads, when the number mounted to about 700.

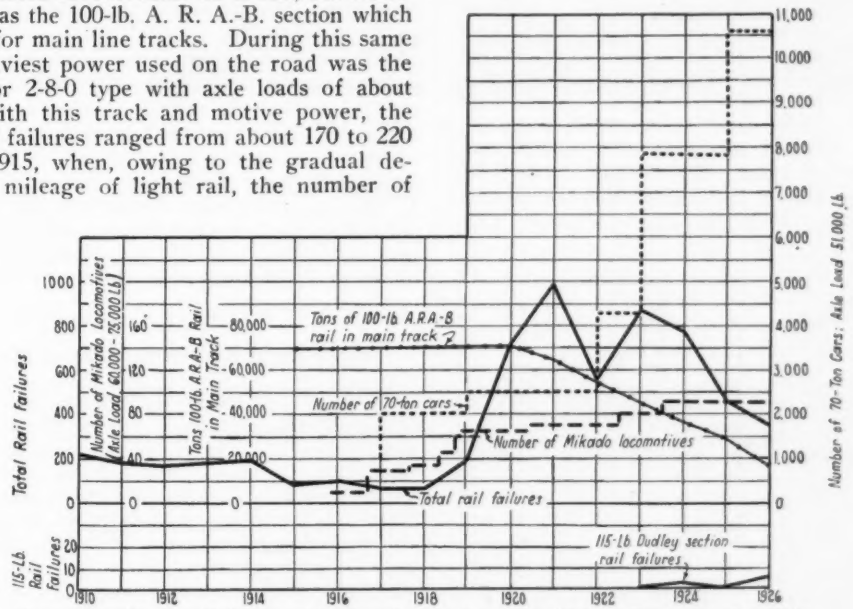


Chart Showing the Relation of Rail and Axle Loads to Rail Failures on the Main Tracks of the P. & L. E.

Analyzing Causes of Failures Leads to Adoption of More Rigid Rail

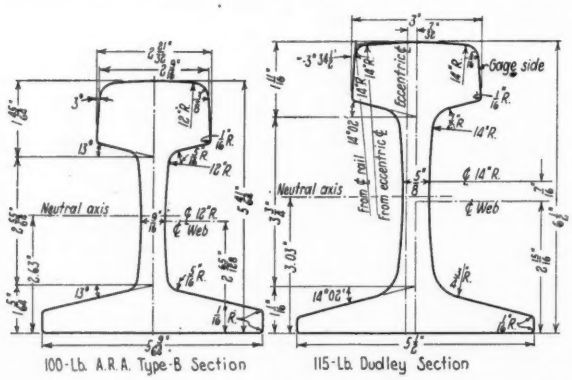
Apparently the 100-lb. A. R. A. rail with its relatively thick head and shallow web was not capable of carrying the increased loads, so in 1921 the Pittsburgh & Lake Erie began to replace this rail with the 115-lb. Dudley section rail, in which an attempt was made to secure increased strength but more particularly, a large increase in girder strength and stiffness. These characteristics were found in the new section, where a reapportionment of the metal gave the rail a relatively smaller head and base but a considerably greater over-all depth and fishing distance. The effectiveness of the new section in afford-

ing increased rigidity is evidenced by the fact that with only 15 per cent more metal it provides approximately 50 per cent greater stiffness.

The reason for desiring rail of greater stiffness is apparent from a study of the action of rail under moving loads, in which it can be assumed to approximate a continuous beam with continually varying points of support and therefore subject to a continual reversal of stresses. This situation is shown in the sketch where the ordinary relation of the locomotive drivers to the rails has been reversed to indicate more clearly the actual conditions that exist with respect to loads and reactions on the rail. Here the locomotive drivers, with 60-in. spacing, are shown to support the varying reactions of the roadbed, the dotted line indicating the continuous girder effect or true line of flexure which obtains in the rail. To reduce this wave motion in the rail and the constant reversal of stresses set up by it, and furthermore, to minimize the flexibility of the rails at joints which had been causing the destruction of both the rail ends and the splice bars in spite of a high standard of maintenance, the high Dudley section with correspondingly high rigid splice bars was adopted.

Marked Reduction in Failures Accompanies Use of 115-Lb. Rail

Going back to the original chart and the serious situation that existed with regard to rail failures in 1920, it is seen that with the release of about 7,000 tons of the old 100-lb. rails during 1921, there was an appreciable decrease in the increased number of rail failures during that year, in spite of the fact that the total number of failures reached the unprecedented peak of about 980. During the following year,

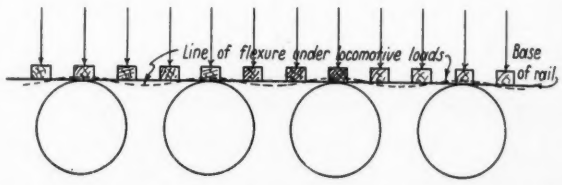


Details of the 100-Lb. A. R. A. Type B Section and the 115-Lb. Dudley Section

with the release of about 10,000 additional tons of the old rail and with little change in loadings, there was a rapid decrease in the number of failures, the total number being only 550, or 430 less than in the preceding year. In 1923, the addition of about 1,750 of the 70-ton cars and the gradual increase in the number of Mikado locomotives in operation, which had now reached a total of 80, again disturbed the trend in rail failures and in spite of the further removal of 9,000 tons of the 100-lb. rail in service, the number of rail failures increased to a second peak of 860.

Since 1923, a more favorable situation has obtained with regard to the number of failures which have occurred yearly, there having been 770 in 1924, 450 in 1925, and a further decrease to 350 in 1926. These marked reductions in the number of rail failures have occurred although the number of 70-ton cars in service increased to 10,600 in 1926, and the number of Mikado locomotives to a total of 91. Accompanying this large increase in loadings, however, has been the continual decrease in the amount of old 100-lb. rail in main tracks, until the rail of this section remaining at the end of 1926 amounted to only 16,000 tons, or about 22 per cent of the amount in service in 1920.

From the foregoing it is evident, therefore, that the solution of the rail failure problem on the Pittsburgh & Lake Erie is being effected through the building up of a track structure such that its relation to the heavier loadings will more nearly approach the situation prevailing from 1915 to 1918,



In Reality the Rail Is a Continuous Beam Supporting the Reactions of the Roadbed

which was conducive to a minimum number of rail failures. That such a condition will undoubtedly be realized within the next few years as the remaining old light rail is replaced by 115-lb. Dudley rail is evidenced by the fact, as shown in the chart, that during the past three years when the amount of 115-lb. rail in service greatly exceeded that of the old 100-lb. section, there was a total of only 11 failures in the heavier section as compared with a total of about 1,570 failures in the much smaller amount of the lighter rails.

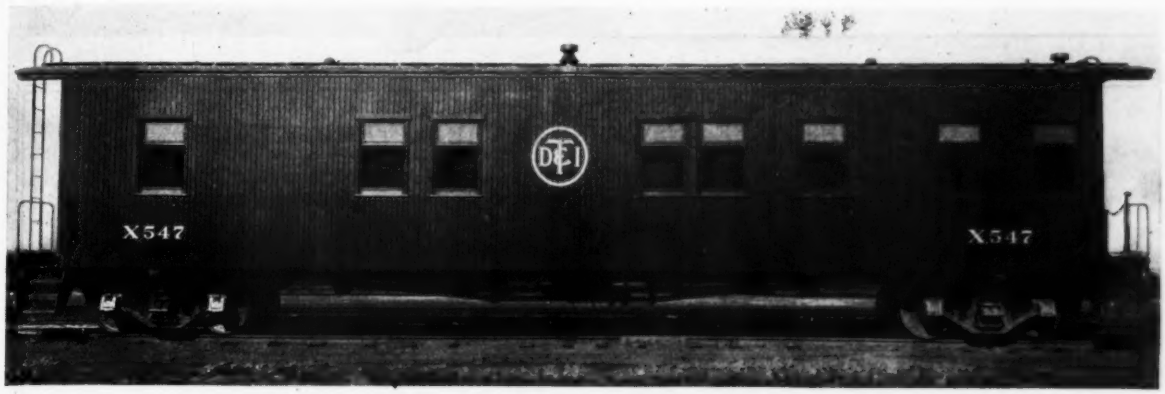
More Rigid Rail Reduces Joint Maintenance

While the reduction in rail failures has been the particular end sought in the adoption of the 115-lb. rail on the P. & L. E., it is interesting to note the effect that the heavier rail section with its more rigid splice bars has had on joint maintenance. With the 100-lb. rail and its shallow 26-in. heat-treated bars, the flexibility of the joints under moving wheel loads was so great that the horizontal component of the vertical stresses caused sufficient abrasive action between the bars and the rail heads and flanges to wear them down, permitting the bars to come in contact with the webs of the rails within about three years. When this condition had been reached it was found that regardless of the use of joint springs or nutlocks, and continual maintenance, it was impossible to keep the joints tight. On the other hand, with the high 115-lb. rail, which has about 50 per cent greater stiffness, and with 38-in. correspondingly stiff, heat-treated splice bars in use, it has been found that the wave motion at the joints, and the horizontal component thereof, have been so reduced that it is possible to maintain tight joints with less maintenance and without the use of spring washers of any kind.

This study of the rail failure situation on the Pittsburgh & Lake Erie has been carried out under the direct supervision of A. R. Raymer, assistant vice-president and chief engineer of that road, to whom we are indebted for the information presented above.

New Outfit Cars on D. T. & I. Are Designed for Comfort

THE Detroit, Toledo & Ironton has recently completed four boarding cars for its employees in which special attention has been given to sanitation and to providing comfortable quarters for the men. Two of these cars have been assigned to the wrecking crews at Springfield, Ohio, and South yard and one each to the bridge and signal departments. The cars, which are 50 ft. long and 9 ft. wide, inside measurements, are built to D. T. & I. specifications, with standard equipment and regulation coach platforms. The exterior is painted a dark coach green, with pyroxylin finish, and the interior is gray. Living quarters are provided in these cars for a gang of 10 men.

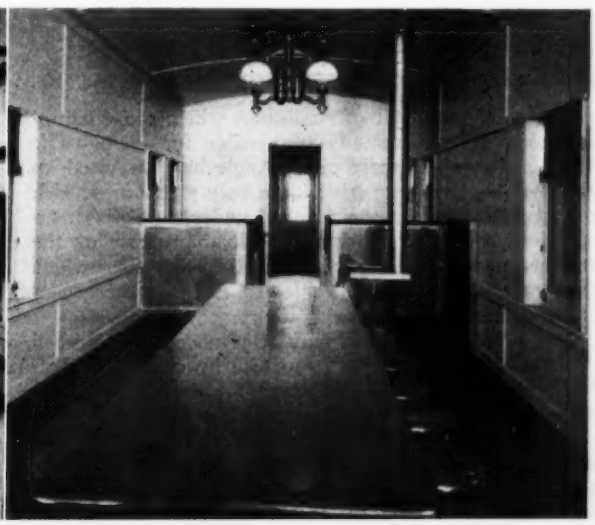


New Outfit Car on the D. T. & I.

Each car has a kitchen, 9 ft. 7 in. long, a dining room 24 ft. 6 in. long, a sleeping compartment 12 ft. 6 in. long, and a clothes press and lavatory are also provided. The kitchen contains a large cooking range, a combination sink, drainboard and coal box, an ice-box, a work table and cabinets. Water is supplied from two 50-gal. tanks suspended from the ceiling, one of the tanks being connected to a cooling coil in the ice-box and the other to a heating coil in the range, thus providing for both hot and cold water. The dining room has an oak table seating 10 men and is heated by a stove. At one end of the dining room two standard Pullman seats are installed which may be made into regular lower berths when necessary. The sleeping compartment has two upper and two lower metal berths on each side, supplied with felt mattresses, heavy woolen blankets and feather pillows.

Ventilation is provided by roof ventilators in every compartment and by a total of 15 windows which are screened and fitted with double hung sashes. Double burner oil lamps hung from the ceiling furnish illumination. The walls are paneled with wall board except in the kitchen, where Flemish iron is used, with a one-inch nickeled strip molding. The floor covering is of heavy linoleum, laid over thick felt paper cemented to the floor of the car, the linoleum being in turn cemented to the felt, thus providing a sanitary flooring which is durable, waterproof and easily cleaned.

The Sleeping Compartment Is Equipped With Metal Berths



The Dining Room Is Attractive

We are indebted to N. L. Van Wegen of the D. T. & I. Railroad News for photographs and information concerning the details of these cars.

What's the Answer?

What Our Readers Have to Say on Current Questions That Perplex Those Engaged in Maintaining Tracks, Structures and Water Supply Facilities

QUESTIONS TO BE ANSWERED IN THE SEPTEMBER ISSUE

1. *What is the best season for rebuilding or repairing right of way fence out of face if this work is to be done by section gangs?*
2. *How can the overdriving of piles be detected and prevented?*
3. *How can the danger of "sun kinks" in track be detected and what can be done to relieve the situation?*
4. *How far can steam or hot water be piped economically in northern climates for heating small stations or office buildings from a power plant or central heating plant?*
5. *To what extent is it economical to clean ballast by hand screening and when this is done should ballast forks or shovels be used in throwing the ballast on the screen?*
6. *What are the relative merits of single acting and double acting pumps for deep wells?*
7. *Is there any practical way of preventing or retarding the growth of vegetation under pile bridges aside from scalping off the sod?*
8. *What special precautions should be taken in the maintenance of corrugated iron or steel used as siding on railway buildings?*

The Prevention of Pumping Joints

What is the cause of pumping joints and what steps may be taken to prevent them?

Insufficient Ballast and Poor Drainage Are Usually the Causes

By J. M. Sills
Division Engineer, St. Louis-San Francisco, Springfield, Mo.

There are a number of conditions which cause pumping joints or are partially responsible for them. The most important of these are: Angle bars too weak to support the joint properly; loose bolts; poor ties; lack of outward slope on the roadbed under the ballast; insufficient ballast to distribute the load properly on the roadbed, and, most important of all, foul ballast which does not permit proper drainage. Each of these contributing causes suggests its own remedy.

If the ballast is foul it may be removed and cleaned or it may be removed and replaced by clean, new ballast. At road crossings drainage conditions may be improved by cutting trenches along the ends of the ties, deep enough to drain properly at each end of the crossing, and filling the trenches with fairly large stones, thus forming blind drains to carry the water away from the joints in or adjacent to the crossing.

Where there is not enough ballast to distribute the load properly and where, for any reason, the amount of ballast cannot be increased, an expensive but effective method is to use a piece of scrap boiler plate, 3 ft. by 6 ft., ¾ in. thick, underneath the ties to distribute the load on the ballast at the joint. The same method has been used successfully for railroad crossings, larger plates being used in such cases. In summing up one may safely say that the cause of pumping joints is usually a combination of poor drainage and improperly distributed loads and that the remedy is a correction of all the contributing factors.

Difficult to Decide What Is Primary Cause

First Assistant Engineer
New York, Chicago & St. Louis

Among the various causes of pumping joints it is difficult to say which is the primary cause. Dirty ballast in conjunction with poor drainage undoubtedly contributes very largely to pumping joints. Where this is the cause the trouble can be overcome by cleaning the ballast and improving the drainage, or by reballasting the track. Where it is necessary to take care of isolated joints only, this can be done by removing the old ballast under the ties that are pumping and replacing it with clean ballast, improving the drainage at the same time, if possible. Pumping joints occur more frequently in dirty gravel or worn out cinder ballast and the use of stone or slag ballast will aid in the elimination of this trouble.

Another cause of pumping joints is battered rail ends with bent, worn or broken angle bars. The remedy for this condition is to build up the battered ends of the rail by welding, at the same time applying new angle bars and bolts. The use of tie plates is also recommended. Loose bolts and rail cut or unsound ties also tend to cause pumping joints and these conditions may be overcome by good maintenance. Ties tamped with end tampers are more likely to pump than those tamped with shovels or tamping bars. Center bound track is

also a contributing factor, in which case a general surfacing with a lift of one or two inches and the use of additional ballast for dressing up will remedy the trouble.

Summing up the matter, the track must have good ballast, good joint ties, proper drainage and a high standard of maintenance, because if these are neglected the result is battered rail ends; bent, broken and worn angle bars; loose bolts, and, finally, pumping joints.

Slot Spiking of Joint Ties Is Often Responsible

By P. C. Perry
Division Engineer, Canadian National, Regina, Sask.

In spite of all the improvements that have been made in angle bars, bolts, etc., the rail joint is still the weak point in our track structure, and it is necessary, therefore, to give special attention to the joints, which require a higher standard of care than the rest of the track. The joint ties should be tamped thoroughly and in gravel ballast, where shovel tamping is usually done, it is well to use tamping bars at the joints.

Slot spiking at the joints has a tendency to cause pumping. The longitudinal movement of the rail causes slot spiked ties to force the ballast away from their sides, thus forming a space between the side of the tie and the ballast, which permits the collection of water at the bottom of the tie. I am convinced that the slot spiking of joint ties is a contributing factor in pumping joints and that the use of rail anchors instead of slot spiking will improve conditions in this respect.

Emergency Stocks of Bridge Material

To what extent is it advisable to keep a stock of piling and bridge timbers on each division for emergency use?

Depends on the Length of the Division

By First Assistant Engineer
New York, Chicago & St. Louis

It is good practice to keep a stock of piling and bridge timbers on each division for emergency use if the divisions are long enough to justify it. On divisions less than 100 miles in length this practice would be very expensive and would be unnecessary, as there probably would not be a pile driver assigned to each short division, in which case the material would arrive at the scene of the emergency long before the driver. One stock of piling and other bridge timber should be sufficient for several short divisions, as it has been my experience that one stock of this character is ample for taking care of fires, washouts and other emergencies on divisions from 400 to 700 miles long. A supply kept in this manner can always move with the driver and crew to any point where it is needed. The size of the stock to be maintained would depend largely on the recommendations of the superintendent of bridges and buildings who is familiar with the local conditions.

Several Divisions Can Often Be Supplied from One Stock

By Division Engineer

The question of maintaining a stock of piling and bridge timbers on each division for emergency use will usually depend on the promptness with which this material can be procured from other sources and the importance of the line, together with the total amount of trestles or other timber bridges on any given territory. While there are still many timber bridges on the railways of this country they are now usually found on the less important lines and the tendency is to reduce their number by replacing them with some form of permanent construction, or if this is not feasible from an economic standpoint, to reduce the fire hazard by the use of ballast decks or some other form of protection.

These changing conditions have lessened the importance of maintaining supplies of this character on each division as compared with former years and it is now the practice to maintain them at some central point where the same stock may serve to protect several divisions in case of emergency. In this way a saving may be made in the actual amount of reserve stock carried on the railway besides the savings that may be made in the handling and care of the material at a comparatively few points instead of at a number of scattered locations.

Repairing Built-Up Roofing

What is the best method of repairing built-up roofing?

Repairs Can Be Made Successfully if Done in Time

By N. H. LaFountain
Chief Supervisor of Buildings, Chicago, Milwaukee & St. Paul, Chicago

Unless decay is too far advanced tar and gravel roofs may be repaired successfully and profitably by removing the gravel, brushing the surface clean, and recoating the roof with a heavy covering of coal tar pitch and gravel. The old gravel should be screened before replacing and the necessary amount of new gravel added to protect the pitch thoroughly from the sun's rays. Roofs allowed to go without recoating until the felt is dry and brittle and more or less cracked are not worth the cost of repairing in the manner described above. The same method may be employed in the repairing of built-up asphalt roofs, except of course, that hot asphalt instead of coal tar pitch should be used.

It Depends on the Extent of the Necessary Repairs

By A. T. Hawk
Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago

When a built-up roof gives trouble we first make an examination to determine whether or not it can be repaired at a reasonable cost and often find that it is possible to do so by first scraping off the gravel and patching the worn or defective places, after which the entire surface is mopped and a cap sheet applied, which in turn is mopped with pitch and covered with washed and screened gravel.

Where the condition of the roof is not so bad we loosen all the gravel on the roof, sweeping up the loosened material and screening it thoroughly. The dirt is removed from the roof and the cracked or defective surfaces are patched by applying three thicknesses of No. 2 felt, mopping each thickness separately. New flashing and counter flashing is installed at all parapet walls and other projections above the roof, after which the entire roof surface is mopped with a uniform coating of hot pitch to which the gravel is applied, adding enough new gravel to the reclaimed gravel to cover the entire roof surface.

Where a roof is reported to be leaking the first thing we do is to look into the flashing and counter flashing, as it is this part of the roof that usually gives trouble, unless it is an old roof on which the

gravel has been washed or worn away, exposing the felt to the elements for a considerable period. Usually on this repair work we secure a five-year guarantee from the contractor, reading as follows:

"The Contractor, in consideration of awarding to it the work covered by the contract to which this specification is attached and is thereby made a part thereof as fully as if set forth therein, does, in addition to its other undertakings and agreements in said contract contained, guarantee:

"(a) That the roofing constructed by the contractor under said contract will remain in an absolutely water-tight condition;

"(b) That the composition thereof will not drip and that the gravel used for the top surfacing will stay intact and not come off; and,

"(c) That the said roofing will not blow off under 'ordinary conditions'; by 'ordinary conditions' being meant anything less than a cyclone or tornado which would wreck the building, or blow off part or parts of the timbers forming the frame work of the roof structure or the roof boards covering the roof structure.

"All of the above guarantees shall extend for a period of five years from and after the date of acceptance of said work by the Railway Company."

Making Tie Renewals When Surfacing Out of Face

In making a general overhauling of main tracks is it economical to leave ties which will give only one more year of service or should all ties be removed which will not give a minimum service of two years?

It Depends on Local Conditions

By L. L. Adams

Roadmaster, Louisville & Nashville, Louisville, Ky.

Local conditions must determine if it is economical to remove ties which will give only one more year of service. If the roadbed is soft and cinder ballast is used, so that the track must be surfaced every year it is economical to leave these ties in the track.

Where the track is on hard ballast and is only surfaced every two or three years it is not economical to leave such ties in the track but all ties should be removed which will not give a minimum service of two years. Where it is necessary to spot in ties the second year the labor costs of putting them in are excessive and it is practically impossible to secure a good riding track where the ties have been spotted in without giving the entire track a light surface.

The most economical way to maintain track on hard ballast where conditions are such that the track must be surfaced every three years is to renew the ties so that none will have to be spotted in the next year, a few spotted in the second year and the track given another general overhauling in the third year.

Several Factors Must Be Considered

By Engineer Maintenance of Way

The decision as to removing ties when main tracks are given a general overhauling will depend on the general policy of the road in making its tie renewals. This is generally interlocked with the policy of surfacing the track out of face, and this in turn often depends on the kind of ballast. If it is the practice to surface one-third of the track out of face on each section every year, which is often done on lines having stone ballast, there is no economy in leaving ties that will not last at least two years longer, since the extra cost of spotting in the ties will more than offset the saving secured in the longer life of the ties. In addition spotting in ties on stone ballast usually has a bad effect on the surface of the track, due to the inability to secure tamping that will be uniform with the older ties in the track.

On the other hand, where gravel ballast is used, it is often the general practice to spot in all the tie renewals except at long intervals when it may be necessary to surface the track out of face. Since tie renewals may be made in gravel or similar ballast much more cheaply than in stone ballast and since it is also easier to maintain uniform tamping in such ballast, it is usually economical, when making a general overhauling of such tracks, to leave ties that will give two more years of service but to remove those which otherwise would have to be taken out the following year.

The condition of the adjacent ties must always be taken into consideration and all doubtful ties that are left should have good ties on each side of them. In renewing ties the policy should be to avoid allowing the older ties to become bunched and this can be easily accomplished at no great expense with proper supervision.

Ties That Will Not Last Two Years Should Be Taken Out

By W. C. Vandiver

Supervisor, Louisville & Nashville, LaGrange, Ky.

Important main tracks should be surfaced out of face every two years and when this is done all ties that will not last two years in service should be taken out, otherwise those with only one year of remaining service life will have to be spotted in the next year, resulting in either rough riding track or the necessity of surfacing the track out of face every year. On branch lines with light traffic the ties can be spotted in each year and the track given a general overhauling not oftener than every three years, so that there is no economy in removing ties that will last until the following year.

On main lines the extra labor due to the damage to the general surface and the rail caused by spotting in ties will be more than double what is saved in the extra life of the ties, since it is impossible to tamp the ties that are spotted in so that they will be uniform with the adjacent ties that are undisturbed. After a few ties have been dug in to each rail the rail will become surface bent at these places, with the result that the track cannot be maintained to the proper surface.

Should the Roadmaster Carry a Reserve Stock of Tools?

To what extent should a reserve stock of tools be maintained at each roadmaster's headquarters for emergency uses?

No Reserve Stock Should Be Carried

By First Assistant Engineer

New York, Chicago & St. Louis

It is unnecessary for a roadmaster to carry a reserve stock of tools at his headquarters for emergency use and such a practice is expensive. The storekeeper is the logical man to handle track tools whether for emergency or other uses, as he always has men available for loading and shipping them, while the roadmaster or his clerk would have to use the section force at headquarters, perhaps taking them away from important work which might result in serious delays. The storekeeper is always prepared to supply any particular kind of tool in any reasonable quantity while the road-

master's stock would be limited to a certain number of each different kind of track tool.

In the event of an emergency for which additional tools are needed these could be assembled easily from adjoining sections, probably before a sufficient number of men arrived to require additional tools, and by that time the storekeeper would probably have the tools either on the ground or enroute.

The interest on the investment for the additional stock would amount to a considerable sum and the tools would depreciate from lack of use. There is also the probability that tools would be borrowed from this stock and not returned, so that when the roadmaster needed his reserve stock it would be very much depleted.

The Roadmaster Should Carry Enough Tools to Equip a Gang of 20 Men

By W. C. VANDIVER

Supervisor, Louisville & Nashville, LaGrange, Ky.

Each roadmaster should have enough tools on hand to equip a gang of 20 men at any time for emergency use, and in addition should have enough tools of each kind to replace those sent in for repairs. The number of tools of each kind to be kept on hand would depend on the number of men working on the division.

Not Needed If Tools Are Supplied Promptly from the Storehouse

By ROADMASTER

The value of a reserve stock of tools at the roadmaster's headquarters hinges very largely on the provisions made for supplying tools quickly when needed without the requisitions having to go through the routine channels. The cost of carrying surplus tools is well understood but the cost of not having tools when needed is not always given the recognition it deserves. It has been found that where tools can be supplied quickly when needed there is not the same incentive for the section foreman to load up his requisitions to "all the traffic will bear" to make sure that he will not lack the tools necessary to carry on his work.

Where the routine of supplying tools is such that a considerable period must elapse between the time the foreman requests the tools and the time he receives them, it usually will be advisable to have a stock of tools at the roadmaster's headquarters so that they may be supplied promptly to the sections when emergencies require their prompt shipment. When such a system is put into effect it should be surrounded with safeguards so that the tools can be issued only by the properly designated persons, either the roadmaster or his clerk, and records kept so that the stock may be checked up at any time. Toward the close of the working season these stocks may be drawn on for filling regular requisitions so that the practice need not necessitate carrying a larger total stock than if all tools were issued direct from the storehouse.

The objections to this plan are that the total stock of tools for a division is increased materially and that there will be a loss from unauthorized "borrowings" from the roadmaster's stock. It must be admitted that careful supervision is needed to prevent both these conditions and that the issuance of all tools direct from the storehouse will give better control. To this end provisions should be made so that emergency requisitions may be put through and filled promptly, to be followed by confirmatory requisitions through the regular course. Where such a plan is in force there is no need for the roadmaster to carry a reserve stock, and he will be relieved of a task requiring time and attention.

The proper balance between the tools a foreman has and what, under certain conditions, he will order is a problem that requires careful watching. An oversupply of tools, or the lack of tools when needed, are alike conducive to high costs of maintenance, and any plan that will insure the desired balance is the one to be adopted. Under the proper organization the issuance of all tools direct from the storehouse or supply train is preferable.

The Effect of Hot Water on Suction Lifts

What are the practicable limits to which hot water of different temperatures may be raised in suction lines?

Partial Vacuum Reduces the Boiling Temperature of Water

By M. B. MACNEILLE

Manager Pump Division, Fairbanks, Morse & Co., Chicago

When pumps are installed to handle hot water the height to which the water can be lifted by suction, as compared with cold water, is greatly reduced by reason of the water boiling at reduced temperatures under low absolute pressure.

The accompanying chart shows both the theoretical and practical values for suction lifts when pumping water of various temperatures at sea level. It will be noted that for a temperature of 165 deg. F. and above no suction lift is permissible in good practice; in fact, the water must flow to the pump under a positive head. At the boiling point, 212 deg. F., slightly more than 12 ft. of dynamic or positive head is necessary for good performance.

Care must be taken when laying out the pump suction line for hot water to avoid too small a pipe and unnecessary bends or fittings, since the friction loss in the suction line obviously will reduce the available static head on the pump suction by the amount of the friction losses in the suction line. Hence a large suction pipe with long sweep fittings and a low velocity of flow will give minimum friction losses and therefore a maximum available head on the pump suction.

Care must be exercised to maintain the installation properly and to keep the pump properly packed and water-sealed to prevent the entrance of air to the suction side of the pump since a small amount of air in handling hot water (this is also true of cold water) will seriously interfere with efficient performance and will greatly diminish the volume delivered.

The following tabulation taken from the chart shows practical suction lifts or heads for temperatures ranging from 140 deg. F. to the boiling point.

Temperature of the Water, Deg. F.	Practical Suction Lift
140	— 7.5 ft.
160	— 2.0 ft.
180	+ 4.5 ft.
200	+ 9.5 ft.
212	+12.5 ft.

The negative sign indicates the number of feet of suction lift which is practicable at the temperatures indicated, while the positive sign indicates the dynamic head which must be applied in order to secure efficient operation.

These values are applicable either to displacement pumps or centrifugal pumps, but when displacement pumps are installed to handle hot water, care must be exercised to insure that such pumps are not operated at piston speeds in excess of those recommended

by the manufacturer for this service, if efficient operation is expected.

The foregoing values, as will be noted on the chart, are based on the atmospheric pressure at sea level. When pumps are installed at higher altitudes allowances must be made for the consequent reduction in atmospheric pressure which means that suction lifts must be reduced and for the higher temperatures the positive head on the pump suction must be increased.

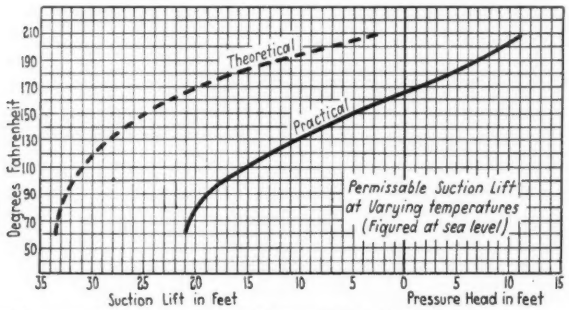


Diagram Showing Theoretical and Practical Values for Suction Lifts with Water of Various Temperatures

Conditions of Practice Reduce Theoretical Values

C. B. White
Cochrane Engineering Company, Chicago

The question of suction lifts for hot water is an interesting one, especially in the study of power plant design and power plant conditions. There is no particular mystery about it, however, because it is really a very simple question from both the standpoint of theory and of practice.

If an attempt is made to lift water having a temperature of 212 deg. or higher by suction there is a steam flash that prevents the pump from functioning. If however, the water is at a lower temperature, say 209 deg. F., it is possible, theoretically, to lift it approximately 1.5 ft. As the temperature decreases the possible suction lift increases until, at a temperature of 100 deg. F., the theoretical suction lift is 27 ft. As stated, these are the theoretical values, but the writer does not want to be understood as advocating them for actual practice.

It might be desirable to indicate some additional values for the lifting power of pumps at varying temperatures between the limits mentioned. It should be borne in mind, however, that these are theoretical and not practical values, and that they apply to sea level only.

Temperature of Water, Deg. F.	Theoretical Suction Lift, Ft.
212	0
209	1.5
201	5.5
198	8.0
193	9.0
189	12.0
182	14.0
170	18.0
162	19.0
153	22.0
142	24.0
126	26.0

It must be remembered also that theory and practice are not always consonant, and the conditions under which pumping is done have a definite bearing on the results to be obtained in practice, while theory assumes ideal conditions. In practice some of the factors which contribute to reduce these theoretical values are the condition of the pumping equipment, the size of the suction pipe and the friction losses in the suction line, the speed of the pump, the relation of the pump capacity to the requirements and the introduction of air in the pump.

A Manufacturer's Practice for Suction Lifts

By Water Service Engineer

The accompanying table is used by one manufacturer who specializes to a considerable extent in hot water pumping equipment, but who also makes an equally large number of cold water pumps, in advising his clients as to what is good practice in making installations of hot water pumps. It will be noted, however, that the table has been expanded to include cold water as well, so that it covers every range of temperature likely to be met in railway water service. The values given for 60 deg. F. can be used for all lower temperatures.

Minimum Allowable Head in Feet on Suction at Various Altitudes in Feet

Temperature of Water (Deg. F.)	Sea Level	2,000	4,000	6,000	8,000	10,000
60	—22	—19	—17	—15	—13	—11
70	—20	—17	—15	—13	—11	— 9
80	—17	—15	—13	—11	— 9	— 7
90	—13	—13	—10	— 8	— 6	— 4
100	—13	—11	— 8	— 6	— 4	— 2
110	—11	— 8	— 6	— 4	— 2	0
120	— 8	— 6	— 4	— 2	0	+ 2
130	— 6	— 4	— 1	+ 1	+ 3	+ 4
140	— 4	— 2	+ 1	+ 3	+ 5	+ 7
150	— 2	+ 1	+ 3	+ 5	+ 7	+ 9
160	0	+ 3	+ 5	+ 7	+ 9	+11
170	+ 3	+ 5	+ 7	+10	+12	+14
180	+ 5	+ 7	+10	+12	+14	+16
190	+ 7	+10	+12	+14	+16	+18
200	+10	+12	+14	+16		
210	+12	+15				

If the installation is made at any altitude above sea level, the atmospheric pressure is decreased, with the result that the suction lift must be decreased or the dynamic head increased, depending on the temperature of the water to be handled. For this reason both varying temperatures and varying altitudes are given. The values which are specified for these varying conditions are applicable to both centrifugal and displacement pumps, and represent the total suction head, including the friction losses. The negative sign indicates the permissible suction lift while the positive sign indicates the necessary dynamic head which must be applied for the higher temperatures.

It should be kept in mind, however, that it is necessary to run pumps handling hot water at a much lower speed than is permissible with cold water pumps, and that such pumps should never be operated at a speed higher than the manufacturer's rating for this service. While it is possible to pump hot water at higher pump speeds, the efficiency of the pump is greatly reduced and the possibility of damage to the equipment is increased. The writer recalls a case of a boiler feed pump in a power plant which was operated by the mechanical department but maintained by the water service department. Although the manufacturer's rating of the pump was considerably above the boiler feed requirements, not only did it not deliver the amount of water demanded, but it required constant and rather expensive maintenance. In fact, the maintenance over a comparatively short period had exceeded the original cost of the pump. In addition, the boilers had been fitted with injectors, and a large percentage of the feed water was being introduced by this means,

while a material amount of overflow from the feed water heater was being wasted.

Investigation disclosed the fact that the water was coming from the heater at a minimum temperature of 180 deg. and that the heater, which was supported on a heavy concrete foundation, was so placed that the discharge was at the level of the pump, so that the delivery was made to the pump under no dynamic head. The heater was raised to give a dynamic head of approximately 10 ft., with the result that the pump operated satisfactorily, the use of the injectors was discontinued, and there was a material saving in the amount of coal consumed. This case occurred in a power plant at an engine terminal where there were sudden heavy demands on the boilers for blowing up engines.

Various Factors Must Be Taken Into Consideration

By George A. Herrmann

Worthington Pump & Machinery Corporation, Chicago

In establishing practical limits to suction lifts of pumps handling hot water, capacity and reliability of service must be taken into consideration. Hot water will flash into steam at lower temperatures under partial air pressures than at atmospheric pressure. The hot water, therefore, must flow into the pump under a pressure greater than that at which it would flash into steam at the temperature at which it is to be handled. Pumps operating under extreme suction conditions, therefore, cannot deliver rated capacities and the service rendered is not so reliable.

At sea level water at 160 deg. F. can be pumped without any head on the suction, while water at 180 deg. would require 5-ft. positive head and at 210 deg. a 10-ft. positive head would be necessary. These values are net heads measured at the discharge valve level of a direct acting pump and at the center line of the shaft of a centrifugal pump. Allowances must be made for frictional losses in suction pipes and fittings. Where it is impossible to obtain the heads recommended above the pumps will operate under more severe conditions, but their capacity will be affected and reliability sacrificed.

Protecting Concrete Cinder Pits from Injury by Clam Shell Buckets

Where clam shell buckets are used for removing cinders from concrete cinder pits what is the best method of protecting the concrete from injury?

Bottoms of Pits Should Be Protected by Old Rails Embedded in the Concrete

By Engineer of Buildings

The use of concrete pits into which cinders may be dumped from the ashpans of locomotives and afterwards removed by a clam shell bucket have proved economical in many places, but provision should be made to protect the concrete, especially in the bottom of the pit, from injury due to the impact of the bucket or the scraping action of the jaws as the cinders are being loaded. Sheets of metal, such as old boiler or tank plates, have been used for this purpose, usually when it has been found necessary to provide protection after the pits have been placed in operation, but the most satisfactory method is the use of old rails embedded in the concrete during construction. The rails should run longitudinally with the pit, spaced approximately two feet center to center and placed so that the head of the rail is slightly above the surface of the concrete. Steel plates used for this purpose are subject to corrosion, which is apt to be rapid due to the acids in the cinders, and are also liable to become loosened, while the rails will last as long as the pit itself, their form locking them firmly in the concrete.

The need of protection for the sides of the pit will depend largely on the size and type of the pit. In narrow pits, where the walls form the supports for the track rails no protection for the sidewalls is necessary as the rails protect the top of the walls and the narrowness of the pit prevents any sharp impact of the bucket on the sides of the pit after it has passed the rails. In wide pits where the loading is done in the space between adjacent tracks, no protection for the sidewalls is necessary. Where the loading is done between the track and the wall, protection is not as necessary where there is ample space for the bucket as where this space is limited, as a little care on the part of the operator will prevent the bucket striking the wall in such a way as to cause damage.

Assignment of Motor Cars to Maintenance Gangs

To what extent is it advisable to return a motor car to the same gang after it has been sent to the shop for overhauling or repairs?

Repaired Cars Should Be Returned to the Same Gang

By G. W. Harris

Assistant Chief Engineer, Atchison, Topeka & Santa Fe System, Chicago

There is much to be said on both sides of this question. However, we deem it advisable to have cars returned to their respective sections after having passed through the shops for repairs. We have many cars on our line that are not adaptable to sections which have heavy grades, but which handle sections on the plains territory satisfactorily. These cars vary in design, and when an operator becomes familiar with the class of car he is operating it takes considerable time to familiarize himself with the working parts of a new car assigned to him. We also deem it advisable to have an extra car to be used as a relief car assigned to each division, this relief car to be used only while a car is in the shop undergoing repairs. Handling the distribution in this manner has resulted in more accurate performance records being kept, as it is often necessary to follow up on checking reported mileage and maintenance costs.

Should Be Returned to the Same Gang if It Can Be Done Promptly

By C. H. Ordas

Supervisor of Motor Cars, Chicago, Milwaukee & St. Paul, Chicago

If it can be done promptly, it is advisable to return the car to the same gang for the reason that the foreman is familiar with the operation of that particular car and to a great extent is responsible for the condition it was in when sent in for repairs. If the same car cannot be returned promptly and a car of the same type is available it should be sent to the gang so that the operator will not have to learn how to handle a new type. In this it is assumed, of course, that the car sent in was suitable for the requirements of the gang.

New and Improved Devices

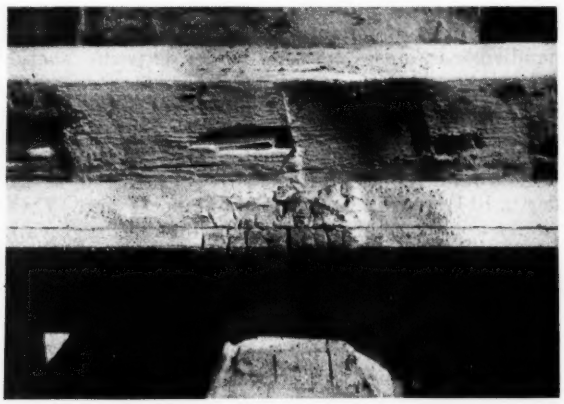
Railroads Test Fire-Resisting Paint

ALL FIRES except those that result from explosions have small beginnings. A spark from a locomotive, a match thrown in some waste, or a cigarette tossed from a train often start a little blaze that may eventually become a great conflagration. Railroads use wood for many purposes for which there are few or no practical substitutes in incombustible materials, and these wooden structures are exposed to many fire hazards. For this reason there has long been a definite need for a surface protection for wooden structures which will be effective in preventing the spread of a fire from various common causes.

During the last three or four years a number of railroads have been making tests of a fire-resisting paint known by the trade name of Burnot, as a result of which this material is now being applied to various types of wooden structures. One road is using it on the wooden frames of track motor cars. Another recently painted the interior of a building which houses electrical apparatus, while a third has purchased 3,500 gal. for application to a large wooden bridge. A number of roads are using it as a paint for signal trunking, extended experiments having been made to determine its effectiveness for this particular use.

Unprotected Trunking After Exposure to a Fire

Burnot is a linseed oil, zinc and lithophone paint which also contains certain other chemicals that render it fire-resistant. It is not claimed that the use of this paint will prevent the burning of a wooden structure exposed to an intense fire or one of large proportions, but that it will resist the heat of a small fire generated from the usual causes in a pile of newspapers or rubbish, a piece of oily waste or a glowing spark brought to rest on a wooden surface. Tests also show that when the wood covered with the material is ignited at the source of a fire the protection will prevent its spreading. The action in retarding fires is said to result from three properties of the paint, namely, to liberate water of crystallization, to throw up heat insulating blisters and to break down mineral constituents to form an enamel glaze or oxygen isolating film under the blanket of blisters.



Protected Trunking After Exposure to a Fire of the Same Intensity

The photographs shown are two taken from a large number illustrating the results of tests of Burnot made on signal trunking by the New York Rapid Transit Corporation. Fires of various intensities were built under sections of treated and untreated trunking with lengths of insulated cable installed within them. These fires ranged in magnitude from that to be produced by a burning newspaper or a piece of oily waste, to such as would result from a fire in a pile of kindling wood. In a few cases the fire was of sufficient volume to burn through the trunking protected by the Burnot, but in the great majority of cases only the surface of the protected wood was charred, whereas the unprotected trunking exposed to the same fire was burned through. In all of the tests the protected wood was burned to a much smaller extent than the unprotected wood subjected to the same intensity of fire. Based upon these tests, it was concluded that "the paint tested cannot be considered as an absolute protection against fire in every instance, but there is no doubt that it possesses fire-retarding properties to a marked degree and as such would appear to be a safeguard

against a considerable percentage of fire hazards."

Burnot is available in various colors and can be applied with either a brush or a spray. The manufacturer also claims waterproofing qualities which will tend to preserve the wood from decay. It is manufactured by Burnot Fireproofing Products, Inc., New York, and is sold by the E. A. Lundy Company, Pittsburgh, Pa.

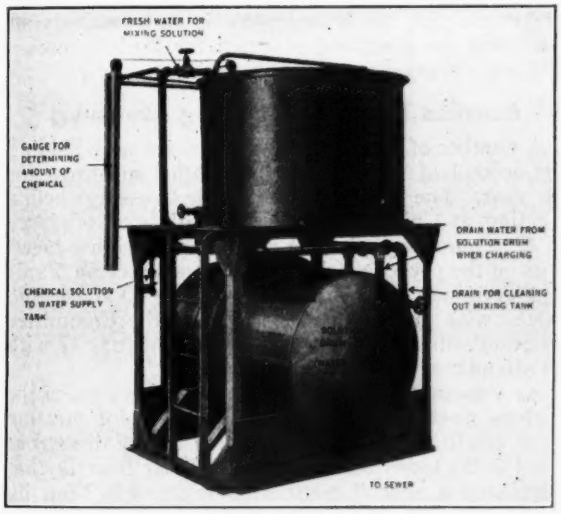
A New Treating Plant for Locomotive Water Supplies

A TREATING plant for locomotive water supplies is now being built by the Dearborn Chemical Company, 310 South Michigan avenue, Chicago, for automatically feeding Dearborn water treating preparations into water supplies where it is desired to do this rather than to introduce them directly into the tenders of locomotives.

The features of the plant are its simplicity and compactness and its ability to proportion the flow of solution to the flow of water and to operate only when there is an actual flow of untreated water.

It consists of a chemical mixing tank A with a chemical mixing basket, and a solution drum B with a diaphragm bag.

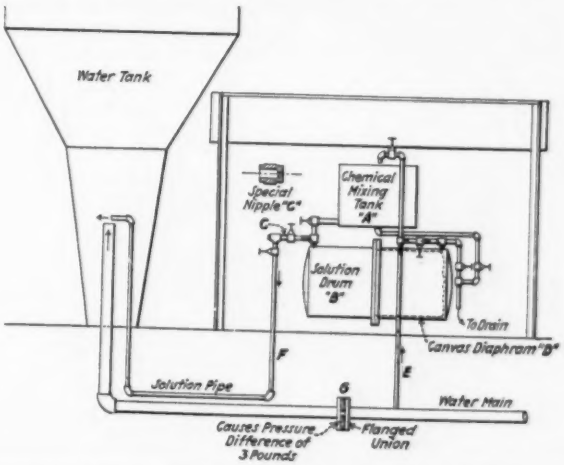
The chemicals are dissolved in the mixing tank A. To charge the plant, the solution in tank A flows by gravity to the solution drum B. This drum is in two halves. Held between the flanges of these halves is a canvas diaphragm.


FRESH WATER FOR MIXING SOLUTION
GAUGE FOR DETERMINING AMOUNT OF CHEMICAL
CHEMICAL SOLUTION TO WATER SUPPLY TANK
DRAIN WATER FROM SOLUTION DRUM WHEN CHARGING
DRAIN FOR CLEANING OUT MIXING TANK
TO SEWER

The Dearborn Treating Plant for Locomotive Water Supplies

The solution entering the solution end of the drum forces the diaphragm across to the opposite end until the drum is full of solution. At the same time, water that has accumulated in the water end of the drum is forced out of the drum and into the outside drain or sewer in the charging process. The water main leading to the storage tank has inserted in it a flanged union, between the two sides of which is a metal plate G. This plate has a hole in it of such size as to cause a back pressure of about 3 lb. per sq. in. in the average flow of water. From the higher pressure side of this plate G a 1½-in. pipe leads to the water end of the solution drum. A 2 in. pipe leading out from the solution end of the drum conveys the chemical to the storage tank, where it mixes with the incoming water.

The reason why any solution should flow to the large supply tank is not apparent from an inspection of the plant. When water flows through plate G a back pressure is caused, by virtue of which part of the water is by-passed through pipe E to the water end of the drum. The diaphragm is gradually pushed towards the opposite end of the drum, forcing the solution out through pipe F and up into the water tank. The rate of flow of the solution is controlled by means of a constriction in the treatment line at the special nipple C. This nipple is closed at one end, except for a hole $\frac{3}{32}$ in. in diameter. At 3 lb. back pressure the flow through this hole would be about 20 gal. per hour. The relative amounts of solution and water flowing depend on the relative areas of the two constrictions at C and at G.



General Arrangement of the Dearborn Plant for Treating Locomotive Water Supplies

A 2-in. hole at G would mean that the amount of water flowing would be 450 times as great as the flow of solution through a $\frac{3}{32}$-in. hole at C, the areas of the two holes being as 450 to 1. When the water stops flowing the excess pressure, of course, disappears and consequently the flow of the solution stops. Moreover, any flow of water, however variable, causes a back pressure that always results in a flow of solution proportionate to the flow of water.

The drum is designed to hold enough solution to last at least 24 hours at the average water station. The only attention the plant needs is to mix up the specified quantity of Dearborn treatment once a day and charge the drum, an operation requiring about 20 min. At heavy watering stations it may be necessary to charge the plant two or possibly three times in 24 hours.

The plant is manufactured in two sizes. The larger unit occupies a floor space about 6 ft. by 7 ft. and is 8 ft. high. A building 12 ft. by 16 ft. by 12 ft. 6 in. high inside, located close to the supply tank, should be provided to house the apparatus and provide storage room for a supply of water treatment. The dimensions of the small unit are 4 ft. 3 in. by 5 ft. 7½ in. in height and it requires a floor space about 5 ft. square.

The chemical mixing tank A is constructed of No. 10 gage tank steel. The seams are electrically arc welded. All tappings are reinforced with forged steel bosses welded to the tank. The solution drum is composed of $\frac{3}{16}$-in. tank steel with $\frac{5}{16}$-in. heads.

The diaphragm bag is made of heavy duck, water-

proofed and reinforced. The solution drum is designed for a working pressure of 80 lb. per sq. in. and is tested at 150 lb. per sq. in.

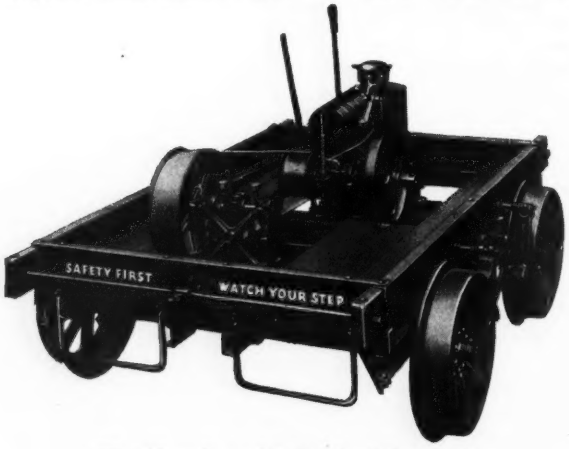
A New Casey Jones Section Motor Car

THE Northwestern Motor Company, Eau Claire, Wis., has recently placed on the market a new section motor car with a combination belt and chain drive, the car being designated as the Casey Jones 522. In its general design the new car is similar to the Casey Jones 521, the main difference being in the drive, which is this car consists of a belt from the engine to a countershaft, with a roller chain drive from the countershaft to the axle.

The countershaft if of simple design and provision is made for adjustment to take up the slack of the roller chain, which runs on cast steel sprockets care-

The Casey Jones 522

fully machined and fastened to the countershaft and driving axle by means of keys. The countershaft runs in SKF self-alining ball bearings, each bearing being provided with a ratchet type grease cup for pressure lubrication. This type of drive is said to be particularly efficient where heavy snow is prevalent, since the roller chain will operate in deep snow without interference with the belt. The car is

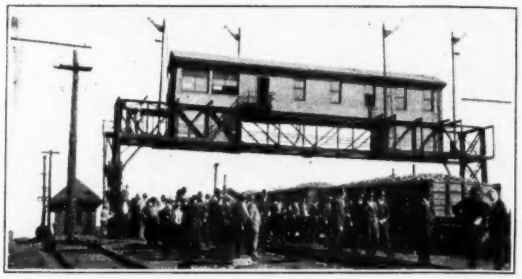


The New Car with the Seat Removed

equipped with a Casey Jones standard six-horsepower water-cooled engine with ball bearings.

The sub-frame of the car is composed of four longitudinal three-inch steel channels securely braced with steel angles to provide rigidity to the car body. The tool trays are deep and convenient lifting handles and drawbar connections are furnished at both ends of the car.

With the Associations



Roadmasters' Association

Because of various complications, arrangements for a meeting of the Executive Committee in June had to be abandoned. Plans are now being made to hold this meeting at Buffalo during the latter part of July.

Bridge and Building Association

A canvass of the work by the various standing committees shows that the committee work is now practically 50 per cent complete. Three of the committees are now making final drafts of their reports. The local committee appointed to prepare plans for the convention at Minneapolis is now actively at work but the complete program for the convention will not be announced for about 30 days.

American Railway Engineering Association

A number of standing committees are now holding the second of their regular scheduled meetings for the year. The Committee on Grade Crossings held a meeting at Chicago on June 28 with an attendance of 22, a number of the sub-committees holding meetings on the preceding day. The Committee on Yards and Terminals held a meeting on June 20 at Detroit, Mich., with an attendance of 21 and the Committee on Standardization met at New York on June 17 with an attendance of 18.

As a means of obtaining a permanent record of the various methods applied and developed for meeting flood conditions during the course of the disastrous flood in the lower Mississippi, President Brumley has appointed a special committee which has been instructed to prepare a symposium on flood fighting methods. It is planned to publish this in a bulletin of the association at an early date.

Directory of Associations

American Railway Bridge and Building Association.—C. A. Lichty, secretary, 319 North Waller avenue, Chicago. Next convention, October 18-20, 1927, Hotel Nicollet, Minneapolis, Minn.

American Railway Engineering Association (Works in co-operation with the American Railway Association, Division IV).—E. H. Fritch, secretary, 431 South Dearborn street, Chicago. Next convention, March 13-15, 1928, Chicago.

American Wood Preservers' Association.—E. J. Stocking, secretary, 111 West Washington street, Chicago. Next convention, January 24-26, 1928, Montreal, Que.

Bridge and Building Supply Men's Association.—B. J. Wilson, secretary, Pocket List of Railroad Officials, 1428 Lytton building, Chicago. Annual exhibit at convention of American Railway Bridge and Building Association.

National Association of Railroad Tie Producers.—E. A. Morse, secretary, Potosi Tie & Lumber Company, St. Louis, Mo. Next convention, April 24-26, 1928, Arlington Hotel, Hot Springs, Ark.

National Railway Appliances Association.—C. W. Kelly, secretary, 1014 South Michigan avenue, Chicago. Annual exhibit during convention of American Railway Engineering Association.

Roadmasters' and Maintenance of Way Association.—T. F. Donahoe, secretary, 428 Mansion street, Pittsburgh, Pa. Next convention, September 20-22, 1927, Hotel Statler, Buffalo, N. Y.

Track Supply Association.—W. C. Kidd, secretary, Ramapo-Ajax Corporation, Hillburn, N. Y. Annuual exhibit at convention of Roadmasters' and Maintenance of Way Association.

The Material Market

A REVIEW of current activities in the material market shows a further contraction in demand. The unfilled orders on the books of the United States Steel Corporation on May 31, 1927, totaled 3,050,941 tons or the smallest volume since December, 1910. This in itself is of no particular significance because of changes in the manner of doing business. Buyers do not place orders so far in advance of delivery as they used to. While the total for May 31 represents a heavy drop as compared with the total of 3,546,132 tons on April 30, it is not as great a drop as occurred during March.

An examination of the table of iron and steel prices shows recessions in a great many items; in fact, in nearly all of them except those of track materials. Quotations on wire products, which declined in May, show a further reduction in June. Attention is directed, however, to the fact that this is a quiet season for such material. Structural steel is soft, particularly in the East; in fact there has been an increase in the spread between Pittsburgh and Chicago prices.

Iron and Steel Prices Per 100 Lb.

	May				June			
	Pittsburgh		Chicago		Pittsburgh		Chicago	
Track spikes	.....	$2.80	.....	$2.90	.....	$2.80	.....	$2.90
Track bolts, ⅞ in. and over	3.90 to	4.00	.....	3.90	3.90 to	4.00	——	3.90
Track bolts, ¾ in. and under	70% off list		70% off list		70% off list		70% off list	
Angle bars	.....	2.75	.....	2.75	.....	2.75	——	2.75
Tie plates, steel	.....	2.35	.....	2.35	.....	2.35	.....	2.35
Boat spikes	.....	3.25	.....	3.25	.....	3.25	.....	3.25
Plain wire	.....	2.40	.....	2.45	.....	2.40	.....	2.40
Wire nails, keg	2.50 to	2.55	2.55 to	2.60	.....	2.50	.....	2.55
Barb wire, galv.	3.20 to	3.25	3.25 to	3.30	.....	3.20	.....	3.25
C. I. pipe, 6 in. to 12 in., ton	.....	.....	43.20 to	44.20			42.20 to	43.20
Plates	1.80 to	1.90	.....	2.00	1.80 to	1.85	.....	2.00
Shapes	1.80 to	1.90	.....	2.00	1.80 to	1.85	.....	2.00
Bars, soft steel	1.85 to	1.90	2.00 to	2.10	1.80 to	1.85	.....	2.00
Rivets, struc	.....	2.75	.....	2.85	.....	2.75	.....	2.85
Conc. bars, billet	.....	1.90	.....	.....	1.80 to	1.90	.....	2.15
Conc. bars, rail	1.70 to	1.80	1.90 to	2.00	1.65 to	1.80	.....	1.90
Rails, per gross ton, f. o. b. mills	.....	.....	.....	43.00			.....	43.00

Activity in Railway Purchases

In contrast with this general picture is the activity in railway purchases. Orders for freight cars during the past month totaled nearly 7,000 cars. Bridge projects have been responsible for contracts covering a considerable tonnage of structural steel. In line with the prevailing tendency for an earlier disposal of rail renewal programs, the railroads are specifying against their contracts for rail at a rate that points to an early completion of rollings on orders placed last fall, production having declined to about 75 per cent of capacity late in June.

Scrap Prices Per Gross Ton at Chicago

	May	June
Relaying rails (including angle bars)	$26.00 to $31.00	$26.00 to $31.00
Rails for rerolling	15.25 to 15.75	14.75 to 15.25
Rails less than 3 ft. long	15.50 to 16.00	15.00 to 15.50
Frogs and switches cut apart	13.50 to 14.00	13.00 to 13.50
Steel angle bars	13.50 to 14.00	13.00 to 13.50

In the meantime, inquiries are coming in for new rail business, including 50,000 tons from the Pennsylvania, 37,000 tons from the Southern and a total of 20,000 tons from two other roads. The Pennsylvania is also inquiring for 5,000 kegs of spikes, 3,000 tons of tie plates, 1,200 tons of angle bars and 1,000 kegs of bolts. The Southern Pacific in an earlier inquiry specified 25,000 kegs of spikes and bolts. Miscellaneous inquiries at Chicago totaled 8,000 kegs of spikes and bolts during the month.

Scrap Prices Are Lower

The scrap market is dull and prices suffered a further decline so that present levels range from $1.75 to $3 lower than in January and are now lower, on the average, than at any time since the early part of 1922.

A comparison of the operations of the Southern pine mills during the first half of this year with the first half of 1926 shows that business has been conductetd on a slightly smaller scale during 1927. The totals of orders, production and shipments are all somewhat smaller. Unfilled orders at this time are moderately larger than a year ago, but the seasonal decline in the total has been more abrupt than it was during May and June of 1926. Dealers report rather dull business and prices are moderately soft.

Southern Pine Mill Prices

	May	June
Flooring, 1x4, B and B, flat	$41.49	$40.42
Boards, 1x8, No. 1	35.93	33.43
Dimension, 2x4, 16, No. 1, common	26.65	26.52
Dimension, 2x10, No. 1 common	30.61	26.00
Dimension, 2x4, 16, No. 1 common	23.83	23.78
Dimension, 2x10, No. 2, common	24.38	22.29

Douglas Fir Mill Prices

	May	June
Flooring, 1x4, No. 2 clear, flat	$27.00	$27.00
Boards, 1x8, 6 to 20, No. 1, common	16.00	16.00
Dimension, 2x4, No. 1, common	17.00	17.00
Dimension, 2x10, 16, No. 1, common	17.00	17.00
Timbers, 6x6 to 8x8, No. 1	20.00	20.00
Timbers, 10x10 to 12x12, rough	19.00	19.00

Reports from the west coast are conflicting and do not permit of a definite statement. The nominal prices are stationary as usual.

Prices for Portland cement, which are per barrel in carload lots, not including package, are the same as last month except for the marked jump from $1.15 to $2.22 at Montreal.

New York	$2.03	Minneapolis	$2.22
Pittsburgh	2.04	Denver	2.85
New Orleans	2.40	Dallas	2.05
Chicago	2.05	San Francisco	2.51
Cincinnati	2.32	Montreal	2.22

Vertical Lift Span in the Rock Island's Bridge Over the White River in Arkansas

Railway News Briefly Told

The Central New England has officially gone out of existence as an operating company and the property has been divided up among various divisions of the New York, New Haven & Hartford for operation.

Railway equipment, including more than 5,000 freight cars and 12 locomotives, which has been in storage at Seattle, Wash., and Vancouver, B. C., since 1917, awaiting shipment to the Imperial Russian Government, has been sold to a company at San Francisco, Cal., for junk. The equipment was en route to Vladivostock when held up at Seattle by the Russian revolution.

The Bullfrog Goldfield has applied to the Interstate Commerce Commission for authority to abandon its line from Goldfield, Nev., to Beatty, 79 miles. The line was built at the time of a mining boom which afterwards collapsed and the owners state that there is no reasonable ground for hoping that the road can ever be operated at a profit.

The completion of the line of the Atchison, Topeka & Santa Fe from Caney, Kan., southwesterly through Pawhuska, Okla., to Fairfax, a distance of 64 miles, was celebrated at Pawhuska on June 16, when Governor Henry A. Johnson, of Oklahoma, drove a golden spike in the presence of townspeople, railway officers and members of 27 Indian tribes.

The use of a poisonous spray for retarding the growth of weeds on railway tracks and rights of way is a violation of a state law of Nebraska, according to a ruling of the Nebraska State Railway Commission, in a complaint filed by farmers along a line of the Chicago, Burlington & Quincy, which stated that livestock had been killed from grass so treated along the right of way.

The name of Coal Creek, Ala., a station on the St. Louis-San Francisco, has been changed to Lindbergh in honor of Col. Charles A. Lindbergh whose relatives have been the only residents of the village for a number of years. Augustus Lindbergh, an uncle of the aviator, was in charge of the Frisco pumping plant at that place until his death in 1909, after which the position was given to a son, Oscar.

In a proposed report by an examiner of the Interstate Commerce Commission it is recommended that the application of the New York Central for authority to lease for 99 years the Cleveland, Cincinnati, Chicago & St. Louis and its subsidiaries, as well as the Michigan Central and Chicago, Kalamazoo & Saginaw, be denied, on the ground that definite provision has not been made to include appropriate connecting short lines in the proposed unification.

Due to the decline in passenger revenues to a point less than the costs of operation, the Colorado & Southern has been granted permission to discontinue for a test period of one year all passenger, baggage and express trains on the Clear Creek district between Denver, Colo., and Silver Plume, on which the famous Georgetown loop is situated. The railroad will be required to carry one passenger car on each freight train and also to file rates for passenger service for parties of not less than 125 persons to any point on the line.

The Pennsylvania ran a special train from Washington, D. C., to New York on June 11 which covered the distance of 226 miles in three hours, seven minutes, or at the rate of 72.5 miles an hour. The train carried motion picture reels of the reception to Col. Charles A. Lindbergh, which were developed on the train and delivered to the motion picture houses in New York about 15 minutes after the arrival of the train; more than an hour earlier than the reels which were taken from Washington to New York by airplane and developed after their arrival.

Revenue freight car loadings for the week ending June 11 amounted to 1,028,305, a decrease of 24,166 cars as compared with the corresponding week of last year but an increase of 38,432 as compared with 1925. Grain and grain products and miscellaneous freight showed increases as compared with last year but all other commodity classifications showed decreases, the decrease in coal loadings amounting to 18,218 cars. The cumulative total for the first 24 weeks of the current year was 23,292,169 as compared with 22,917,146 and 22,350,734 for the corresponding periods in 1926 and 1925, respectively.

A comparison and review of safety activities of the years 1923 and 1926 is the subject of circular No. 156, which has been issued by L. G. Bentley, chairman of the committee on education of the Safety Section, American Railway Association, in its campaign to reduce railway casualties 35 per cent by the end of 1930, as compared with 1923. Each road is reminded that the fact of proportional success thus far does not warrant the conclusion that the goal will be reached, and the responsibility of officers and supervisors for the prevention of accidents should be emphasized constantly. The records show that 44 roads have already reduced accidents 35 per cent; 61 have made reductions of from 15 to 35 per cent; 39 have made slight reductions and 43 have shown increases.

The proposed merger of the Northern Pacific and the Great Northern has been declared operative by the committee which has received deposits of more than 70 per cent of the stock of the two companies for exchange for the new company's stock. The committee has approved application to the Interstate Commerce Commission for approval of the control of the two companies and of the Spokane, Portland & Seattle, now owned by them jointly, by a new company to be incorporated under the laws of Delaware and to be known as the Great Northern Pacific. The plan provides that the new company shall acquire the stock of the two companies by exchanging its own stock therefor on a share for share basis and shall take leases of the properties of the two major companies and of the Spokane, Portland & Seattle.

The request of the trainmen on the western railways for an increase in pay amounting to $1 per day was denied by the board of arbitration which heard the case and which made public its decision on June 25. The same decision granted an increase of 7½ per cent in the wages of car retarder operators, yard foremen, helpers and switchtenders in the same territory. The records show that the present pay of train service employees in the west is approximately equal to that in the east since the 7½ per cent increase was granted in the latter territory, while the yard service employees are in a relatively less favorable position as compared with those in train service than they were in 1915. E. P. Curtis, secretary and treasurer of the Order of Railway Conductors, and J. A. Farquharson, vice-president of the Brotherhood of Railroad Trainmen, members of the board representing the employees, filed dissenting opinions.

Personal Mention

General

C. W. Brown, superintendent of the Lehigh & New England, with headquarters at Bethlehem, Pa., whose railway experience was gained in engineering, has been promoted to general superintendent, with headquarters at the same place. Mr. Brown was born on January 10, 1880, at Ft. Gaines, Ga., and entered railway service on September 1, 1898, in the engineering department of the Central of Georgia. He became a transitman on the Baltimore & Ohio in 1900 and in 1903 was promoted to resident engineer. In August, 1904, he became an assistant engineer on the Atlantic Coast Line and from August, 1906, until May, 1908, he was engineer of roadway for the same road, following which he returned to the Central of Georgia as locating engineer. Mr. Brown became superintendent of the Hall Parker Construction Company in 1910, returning to railway service in August, 1911, as engineer maintenance of way of the Lehigh & New England, remaining in that position until December, 1913, when he entered the operating department as assistant superintendent. In March, 1917, he was promoted to superintendent, with headquarters at Bethlehem, which position he was holding at the time of his recent promotion to general superintendent.

R. K. Rochester, general superintendent of the New Jersey division of the Pennsylvania, with headquarters at New York, who is an engineer by training and experience, has been promoted to assistant general manager of the Eastern region, with headquarters at the same place. **Raymond Swenk,** engineer maintenance of way of the Southern division, with headquarters at Wilmington, Del., has been promoted to superintendent of the Erie and Ashtabula division at New Castle, Pa.

R. K. Rochester

Mr. Rochester was born on December 7, 1877, at Simcoe, Ont., and was educated at Rose Polytechnic Institute. He entered railway service on November 10, 1901, as assistant engineer maintenance of way on the Michigan division of the Vandalia (now a part of the Pennsylvania), and on May 1, 1902, was promoted to acting engineer maintenance of way, this being followed in November of the same year by his appointment as engineer maintenance of way of that division. On June 1, 1905, he was promoted to principal assistant engineer of the Vandalia and on May 1, 1909, he became division engineer of the St. Louis division. Mr. Rochester entered the operating department on July 1, 1913, as superintendent of the Peoria division of the Vandalia and was transferred successively to the Logansport division of the Pittsburgh, Cincinnati, Chicago & St. Louis (now a part of the Pennsylvania) and the Cleveland and Pittsburgh division of the Pennsylvania. He was in military service from February 11, 1918, to January 16, 1919, on which date he returned to the Pennsylvania as superintendent on special duty in the office of the general manager of the Western lines. On August 16, 1919, he was appointed superintendent of the Cleveland and Pittsburgh division and on March 1 of the following year was promoted to general superintendent of the Central Ohio division of the Southwestern region. He was transferred to the Buffalo division on January 16, 1924, and this was followed by his transfer to the New Jersey division on April 1, 1926, which position he was holding at the time of his recent promotion to assistant general manager of the Eastern region.

A sketch of Mr. Swenk's career was published in the March, 1927, issue of *Railway Engineering and Maintenance*.

H. N. Walters, trainmaster on the Cincinnati division of the Chesapeake & Ohio, whose earlier railway experience was in the engineering and maintenance of way departments, has been promoted to assistant superintendent of the Cincinnati and Northern divisions, with headquarters at Covington, Ky. Mr. Walters was born on June 16, 1888, in Fairfax county, Va., and was educated at Washington & Lee University and Lehigh University, graduating from the latter in 1910. On August 10 of the same year he entered railway service with the Chesapeake & Ohio as an instrumentman on yard construction at Stevens, Ky., and on January 1, 1913, was promoted to supervisor of track, with headquarters at Hinton, Va., being transferred to the Piedmont district, with headquarters at Richmond, Va., on February 1, 1914. On August 1, 1914, he was promoted to supervisor of track, bridges and buildings and water supply on the Newport News terminal and this was followed by his further promotion to division engineer of the Hinton division on October 1, 1914, where he remained until July 1, 1918, when he was transferred to the Cincinnati and Northern divisions, with headquarters at Covington, Ky. Mr. Waters entered the operating department on April 10, 1923, as trainmaster on the same divisions and was holding the position of trainmaster on the Cincinnati division at the time of his recent promotion to assistant superintendent.

Engineering

S. F. Grear, office engineer on the Illinois Central, with headquarters at Chicago, has been promoted to assistant engineer of bridges, to succeed Charles Chandler, who resigned to become connected with the J. G. Brill Corporation.

Frank Manning, resident engineer in charge of yard construction and grade revision on the Pere Marquette at McGrew, Mich., has been promoted to assistant division engineer, with headquarters at Grand Rapids, Mich. **H. D. Tubbs,** has been appointed resident engineer at McGrew to succeed Mr. Manning.

H. E. Stuckert, assistant engineer on the Houston Belt & Terminal, with headquarters at Houston, Tex., has been promoted to division engineer of the Houston North Shore and has been succeeded on the Belt & Terminal by **T. A. Youngblood,** assistant division engineer on the International-Great Northern, with headquarters at Houston. All these lines are subsidiaries of the Missouri Pacific.

H. O. Kaigler, assistant division engineer of the Virginia division of the Seaboard Air Line, with headquarters at Raleigh, N. C., has been promoted to division engineer of the West Florida division, with headquarters at Tampa, Fla., succeeding **G. W. Shoemaker,** who has been appointed assistant division engineer of the Virginia division with headquarters at Raleigh, N. C., to succeed Mr. Kaigler.

J. G. Begley, assistant on the engineering corps of the Akron division of the Baltimore & Ohio, at Akron, Ohio, has been promoted to assistant division engineer of the Chicago division, with headquarters at Garrett, Ind., to succeed **C. R. Adsit,** whose appointment as division engineer of the Cincinnati, Indianapolis & Western, with headquarters at Indianapolis, Ind., was noted in the June issue.

William Mahan, whose assignment to special depreciation and valuation work on the Wheeling & Lake Erie with headquarters at Brewster, Ohio, was noted in the June issue, was born on June 4, 1866, in Clyde, Ohio, and entered railroad service on the W. & L. E. on June 10, 1882, as a water boy. In 1883 he was with a fence gang and from then to 1887 he was a bridge carpenter. He then became a fence gang foreman and in 1888 was made a paint gang foreman. During 1890 and 1891 he served as a bridge gang foreman and then was then placed in charge of iron bridge

work, following which, until 1906 he was a bridge foreman. In 1906 he was promoted to bridge superintendent and in 1918 became superintendent of bridges and buildings, which position he was holding at the time of recent assignment to special depreciation and valuation work.

H. M. Long, whose promotion to division engineer on the Chicago, Rock Island & Pacific, with headquarters at Kansas City, Mo., was noted in the May issue, was born on May 4, 1889, at LaFayette, Ind., and was educated at Purdue University. Mr. Long entered railway service in September, 1909, as a chainman and rodman on the Rock Island at Topeka, Kan. In 1912 he was promoted to instrumentman at Des Moines, Iowa, and in 1914 to assistant engineer at Eldon, Mo. He served as apprentice foreman and instrumentman at Herinton, Kan., in 1915, and as masonry and building inspector on the Arkansas division in 1916, later in the same year being made instrumentman at Eldon, Mo., where he remained until 1921 when he was transferred to Kansas City. He later served as roadmaster and assistant engineer at Kansas City and was holding the latter position at the time of his recent promotion to division engineer.

J. H. Cooper, division engineer of the Philadelphia Terminal division of the Pennsylvania, with headquarters at West Philadelphia, Pa., has been promoted to engineer maintenance of way of the Southern division, with headquarters at Wilmington, Del., to succeed **Raymond Swenk,** whose promotion to superintendent of the Erie and Ashtabula division is noted elsewhere in this issue. **H. T. Frushour,** assistant division engineer of the Cincinnati division, with headquarters at Cincinnati, Ohio, has been promoted to division engineer of the Cleveland and Pittsburgh division, with headquarters at Cleveland, Ohio, where he takes the place of **F. M. Hawthorne,** who has been transferred to the Philadelphia Terminal division to succeed Mr. Cooper.

J. H. Cooper

Mr. Cooper was born on July 5, 1883, at Easton, Pa., and graduated from Lafayette College in 1905. He entered the service of the Pennsylvania on October 13, 1905, as a rodman on the Sunbury division and on March 9, 1910, was transferred to the Williamsport division. On August 11, 1910, he was promoted to transitman in the general office at Philadelphia and on January 1, 1911, was further promoted to assistant supervisor on the Tyrone division, being transferred successively to the Conemaugh, the Philadelphia and the Philadelphia Terminal divisions. He was promoted to supervisor on the Trenton division on October 25, 1927, and was transferred to the New York division on March 1, 1920. Mr. Cooper was promoted to division engineer of the Philadelphia division on November 1, 1923, and on January 1, 1926, was transferred to the Monongahela division. On April 1, 1926, he was transferred to the Philadelphia Terminal division, with headquarters at West Philadelphia, where he was serving at the time of his recent promotion to engineer maintenance of way of the Southern division.

W. C. Pinschmidt, assistant engineer in the office of the assistant to the vice-president in charge of operation of the Chesapeake & Ohio, at Richmond, Va., has been promoted to special engineer in the same office. Mr. Pinschmidt was born on June 13, 1894, at Baltimore, Md., and graduated from the Baltimore Polytechnic Institute in 1911. He entered railway service in the engineering department of the Baltimore & Ohio, serving in various positions until January, 1915, when he entered the service of the Norfolk Southern as a draftsman. He returned to the Baltimore & Ohio in May of the same year, as a draftsman in the valuation department at Cincinnati, Ohio. From October, 1915, to September, 1923, he was in the offices of the supervisor of operating statistics and the chief engineer at Baltimore. Mr. Pinschmidt entered the service of the C. & O. as assistant engineer in the office of the superintendent maintenance of way at Richmond where he had charge of the drafting department. On November 1, 1926, he was transferred to the office of the assistant to the vice-president in charge of operation, in which position he was serving at the time of his recent promotion to special engineer.

R. L. Sims, whose promotion to district engineer maintenance of way of the Chicago, Burlington & Quincy, with headquarters at Lincoln, Neb., was noted in the May issue was born on December 12, 1891, at Sturgeon, Mo., and entered railway service with the Chicago, Burlington & Quincy on March 4, 1912. He was promoted to section foreman at Lowder, Ill., in April, 1916, and to extra gang foreman in April of the following year. He was advanced to assistant roadmaster on the Beardstown division on July 13, 1918, and this was followed in November of the same year by his promotion to roadmaster on the same division, with headquarters at Herrin, Ill. In August, 1919, his headquarters were transferred to Centralia, Ill., and in February, 1920, he was transferred to the Chicago Terminals. He was appointed assistant trainmaster on the Beardstown division in 1922 and later in the same year was again appointed roadmaster of the Chicago Terminals. He was transferred to the Brookfield division (now a part of the Hannibal division), with headquarters at Chillicothe, Mo., on October 4, 1926, which position he was holding at the time of promotion to district engineer maintenance of way, with headquarters at Lincoln, Neb.

R. L. Sims

Changes on the Ohio Central Lines

The maintenance of way department of the Ohio Central Lines has been reorganized and the division engineer's office at Bucyrus, Ohio, has been discontinued. The changes due to this action are as follows:

H. F. Schryver, valuation engineer, with headquarters at Columbus, Ohio, has been transferred to the office of the chief engineer, with headquarters at the same place to succeed **C. V. Bucher,** who has been appointed division engineer with headquarters at Charleston, W. Va., in the place of **C. M. McVay,** who has been assigned temporarily to special construction work. **G. H. Smith,** division engineer at Bucyrus, Ohio, has been transferred to Columbus, Ohio, where he succeeds **E. A. Holtsbery. V. L. Nelson** has been appointed acting valuation engineer to succeed Mr. Schryver.

R. A. Black, division engineer of the Halifax division of the Atlantic division of the Canadian National, with headquarters at Halifax, N. S., has been promoted to transportation engineer, with headquarters at Montreal, Que., succeeding **J. F. Pringle,** who has been promoted to assistant general superintendent of transportation of the Central region, with headquarters at Toronto, Ont. Mr. Black was born in England and came to Canada in 1898, entering the service of the Canadian Northern (now a part of the

Canadian National) as a rodman in the same year. Later in 1898 he entered the employ of the Canadian Pacific and served in various capacities on construction work until 1909, when he was appointed location engineer on the National Transcontinental (now a part of the Canadian National) in Quebec. In the following year he was promoted to division engineer on construction on the same district and in 1913 was further promoted to assistant district engineer. He was subsequently resident engineer of maintenance on various districts until 1919 when he was promoted to division engineer of the Campbellton division, with headquarters at Campbellton, N. B. He was transferred to the Halifax division in 1920 and was located at that place at the time of his recent promotion to transportation engineer.

Track

R. J. Royer has been appointed roadmaster on the Chesapeake & Ohio, with headquarters at Chillicothe, Ohio.

Charles R. Kreiger, section foreman on the Pere Marquette at Grand Ledge, Mich., has been promoted to supervisor, with headquarters at Detroit, Mich.

J. C. Walsh, roadmaster on the Canadian Pacific, with headquarters at Montreal, Que., has been transferred to Sherbrooke, Que., to succeed **T. Netterfield,** deceased.

William S. McCarthy, section foreman on the Fargo division of the Northern Pacific has been promoted to roadmaster on the Dakota division, with headquarters at Carrington, N. D.

W. N. Swanson, section foreman on the Centerville division of the Chicago, Burlington & Quincy, has been promoted to roadmaster, with headquarters at Centerville, Iowa, and will have jurisdiction over the lines from Sedan, Iowa, to Carrollton, Mo., and from Sedan to Elmer, Mo., a newly created position.

C. A. Geiger, assistant division engineer of the Ohio Central Lines of the New York Central, with headquarters at Bucyrus, Ohio, has been appointed supervisor, with headquarters at Toledo, Ohio, due to changes in the organization of the maintenance of way department whereby the division engineer's office at Bucyrus was discontinued.

Robert Eshley has been promoted to roadmaster on the Chicago & North Western at Antigo, Wis., to replace **C. S. McConnell,** who has been transferred to Green Bay, Wis., to succeed **M. Hermans,** assigned to other duties. **H. A. Halverson,** former roadmaster, who has been general foreman of a large rail laying gang, has been appointed roadmaster at Wall Lake, Iowa, succeeding **D. J. Hovland,** resigned.

James E. Vandling, assistant supervisor on the Pennsylvania, whose promotion to supervisor, with headquarters at York, Pa., was noted in the June issue, was born on August 11, 1899, at Sunbury, Pa., and was educated at Pennsylvania State College. He entered railway service on December 16, 1922, as a rodman on the Pennsylvania and was promoted to assistant supervisor in April, 1924, in which capacity he was serving, with headquarters at West Philadelphia, Pa., at the time of his recent promotion to supervisor.

P. J. Weiland, section and extra gang foreman on the Chicago, Milwaukee & St. Paul at Mitchell, S D., has been promoted to roadmaster on the Kansas City division at Ottumwa, Iowa, to take the place of **Adam Tubaugh,** who has been transferred to Chillicothe, Mo., on the same division to succeed **R. H. Cunningham,** transferred to the Wisconsin Valley division, with headquarters at Wausau, Wis., to replace **T. McMahon,** who in turn has been transferred to the LaCrosse division, with headquarters at Portage, Wis., succeeding **John Kelly,** deceased.

G. C. Smith, whose appointment as supervisor on the Southern, with headquarters at Greensboro, N. C., was noted in the June issue, was born on May 8, 1893, in Chatham county, N. C., and entered railway service on January 27, 1911, as an extra gang laborer on the Danville division of the Southern. A year later he was promoted to yard foreman at Greensboro and afterwards was promoted to extra gang foreman. He served in this capacity for about 18 months when he entered the construction department where he remained until January 25 when he entered military service in the World War. Returning to the Southern after leaving the army on December 25, 1918, he served as extra gang foreman, being located on the Danville division at the time of his recent promotion to supervisor.

W. K. Tate, assistant engineer on the Nashville, Chattanooga & St. Louis, with headquarters at Tullahoma, Tenn., whose appointment as supervisor in addition to his duties as assistant engineer, was noted in the June issue, was born on January 13, 1898, at Tyler, Tex., and was educated at Vanderbilt University. He entered railway service on February 13, 1917, as a draftsman on the Nashville, Chattanooga & St. Louis in the chief engineer's office at Nashville, being transferred shortly after that time to a survey party where he held successively the positions of draftsman, instrumentman and topographer, until January 1, 1918, when he was promoted to assistant engineer on the Huntsville division, which position he still holds in addition to the duties he has assumed as supervisor in the McMinnville branch.

F. W. Kittleberger, assistant on engineer corps on the Pennsylvania, has been promoted to assistant supervisor on the Buffalo division, with headquarters at Olean, N. Y., to replace **G. A. Sawyer,** who has been transferred to the Pittsburgh division at Pittsburgh, Pa. (south side), to succeed **C. K. Kuszmaul,** transferred to the Pan Handle division, with headquarters at Steubenville, Ohio, a newly created position. **H. E. Conklin,** transitman, has been promoted to assistant supervisor on the Allegheny division, with headquarters at Kittanning, Pa., to take the place of **G. W. Sauvain,** who has been transferred to the Pittsburgh division, with headquarters at Johnstown, Pa., replacing **R. J. Moore,** transferred to the Akron division, with headquarters at Akron, Ohio, to succeed **C. W. Jenkins,** who has been assigned to other duties.

Jeremiah F. McCarthy, assistant supervisor on the Boston & Maine, has been promoted to supervisor, with headquarters at Mechanicville, N. Y., succeeding **William J. Byrne,** retired. **Harold A. Wickens** has been appointed acting assistant supervisor on District No. 2 of the Fitchburg-Berkshire division, with headquarters at Gardner, Mass., replacing **Henry P. Mason,** who has been transferred to District No. 1 on the same division, with headquarters at Waltham, Mass., succeeding **John W. McManama,** who has retired after a service of 54 years with that road.

Mr. McCarthy was born on November 22, 1889 in Ireland. He entered the service of the B. & M. in 1903 as a track laborer and on April 15, 1905, was appointed assistant section foreman, acting in that capacity until April 8, 1907, when he was appointed section foreman at Reynolds, N. Y., where he remained until September 16, 1909 when he became assistant foreman of an extra gang. On January 1, 1913, he took charge of a section gang at Buckland, Mass., until May 10, 1913, when he was transferred to Rotterdam, N. Y., as yard foreman. On January 1, 1926, he was in charge of the hump yard at McVille and on May 1, 1926, was placed in charge of an extra gang at Mechanicville. He worked in that capacity until May 15, 1927, when he was appointed assistant track supervisor, the position he was holding at the time of his recent promotion.

Correction.—In the item in the June issue noting the promotion of **H. D. Roberts** to assistant supervisor on the Pennsylvania, with headquarters at Renovo, Pa., the name was erroneously shown as **D. H. Roberts.**

Bridges and Buildings

J. Boler, supervisor of bridges and buildings on the Ohio Central Lines of the New York Central, with headquarters at Bucyrus, Ohio, has been transferred to Columbus, Ohio.

Warren L. Peoples, whose appointment as superintendent of bridges and buildings on the Wheeling & Lake Erie, with headquarters at Brewster, Ohio, was noted in the June. issue, was born on August 12, 1896, at Bolivar, Ohio,

and was educated at the Ohio Northern University, where he graduated in 1917. He entered railway service during his college vacation in 1916 as a rodman on a maintenance corps on the Wheeling & Lake Erie. After the completion of his college course in 1917 he became a transitman in the valuation department of the same road and in the following year was promoted to terminal pilot. On September 1, 1918, he entered the army and served as a sergeant in the engineer corps until January 1, 1919, when he returned to the Wheeling & Lake Erie as a transitman in the maintenance department. He was promoted to assistant engineer in 1923 and to district roadmaster in 1926, which latter position he was holding at the time of his recent appointment as superintendent of bridges and buildings.

Purchasing and Stores

Morton Dickerson, assistant storekeeper on the Norfolk & Western, with headquarters at Crewe Shop, Va., has been promoted to storekeeper, with headquarters at Simcoe, W. Va. **R. J. Lane** has been appointed assistant storekeeper to succeed Mr. Dickerson.

Eugene Decker, chief clerk to the purchasing agent of the Maine Central, with headquarters at Portland, Me., has been promoted to purchasing agent, with the same headquarters, succeeding **Charles D. Barrows,** notice of whose death appears elsewhere in this issue. Mr. Decker was born on December 18, 1876, at Clinton, Me., and graduated from Shaw's Business College at Portland, Me., in 1893. He entered railway service on June 26, 1893, as an operator at Thompson's Point on the Maine Central, with which road he has been connected continuously since that time. Mr. Decker was transferred to the Portland freight office on August 16, 1893, and on March 3, 1913, was promoted to chief clerk to the purchasing agent, which position he was holding at the time of his recent promotion to purchasing agent.

Obituary

Robert Craig, assistant engineer on the Missouri Pacific, with headquarters at St. Louis, Mo., died on June 2 at the Missouri Pacific hospital in that city.

T. Netterfield, roadmaster on the Canadian Pacific, with headquarters at Sherbrooke, Que., died suddenly early in June while on a motor car trip.

John Kelly, roadmaster on the LaCrosse division of the Chicago, Milwaukee & St. Paul, with headquarters at Portage, Wis., died on June 12, after a service of 52 years with that road.

John Olk, formerly supervisor of bridges and buildings on the Chicago & North Western at Antigo, Wis., who retired on a pension in 1923, died in that city on June 6 from heart trouble.

Thomas Beam, fire patrol inspector on the Erie, with headquarters at Stroudsburg, Pa., died at his home at Stroudsburg on April 23. Mr. Beam started his railroad career with the Central Railroad of New Jersey in 1874 and in 1894 was engaged in construction work in Georgia. In 1895 he became track supervisor on the Southern with headquarters at Knoxville, Tenn., after which, in 1900, he entered the service of the Erie as track supervisor at Jersey City, N. J. Mr. Beam was transferred to Stroudsburg in 1904 and in 1925 was appointed fire patrol inspector, which position he was holding at the time of his death.

Charles D. Barrows, purchasing agent of the Maine Central, with headquarters at Portland, Me., died on May 12, after an illness of several weeks. Mr. Barrows was born on November 12, 1871, at Lowell, Mass., and later lived in San Francisco. He was educated at Dartmouth College where he graduated in 1894. He entered railway service on November 12 of the same year as a clerk in the office of the general passenger agent of the Maine Central. He was transferred to the supply department on November 16, 1895, and on August 1, 1898, was promoted to purchasing agent, which position he was holding at the time of his death.

Construction News

The Atchison, Topeka & Santa Fe has awarded a contract for the construction of buildings in connection with the enlargement of the engine terminal at Emporia, Kan., to C. A. Fellows, Los Angeles, Cal. The structures included in this contract are a 50-stall concrete and brick roundhouse, a one-story apprentice school, a two-story brick locker building, a one-story office building, a brick ice house and a power house. Contracts will be awarded at some future date for cinder and sand handling facilities and a coaling station. Grading, track laying and bridging in connection with the terminal will be done by company forces.

The California, Arizona & Santa Fe, a subsidiary of the Atchison, Topeka & Santa Fe, has been authorized to build an extension from Beardsley for a distance of about 15 miles in Maricopa County, Ariz.

The Atlantic Coast Line has awarded a contract to the Roberts & Schaefer Company, Chicago, for the construction of a 500-ton Simplex Automatic electric coaling station at Lakeland, Fla.

The Baltimore & Ohio has let a contract to the Vang Construction Company, Cumberland, Md., for the construction of a bridge at Greenfield, Ohio, to cost approximately $60,000, and a subway at Cumberland, Md., to cost approximately $25,000.

The Bangor & Aroostook plans to build a 400-ton steel bridge at Houlton, Maine.

The Bessemer & Lake Erie will replace the present timber bridge at Black's Run, Pa., with a new steel bridge, to have a concrete floor. The work will be done by company forces, and will cost about $30,000.

The Boston & Maine is now engaged on an extensive program of improved facilities, the cost of which will aggregate about $8,000,000. This includes plans for the modernization and unification of the Boston & Maine's freight terminals at Boston to include two new car retarder equipped classification yards, one inbound and one outbound. At Mechanicville, N. Y., a complete rehabilitation of the classification and terminal facilities is under way. This project involves an expenditure of about $380,000. At White River Junction, Vt., work on the new classification yard is now well advanced and the yard is in partial operation.

The Canadian National has awarded a contract to the Cooke Construction Company, Montreal, Que., for the grading of an extension of line from St. Felicien, Que., to Mistassini, 27.5 miles. This line, which it is estimated will cost $1,463,000, will involve the construction of bridges over the Ashuapmouchouan and the Ticouabe rivers.

The Canadian Pacific has prepared for the construction of a two-story concrete and brick office building with outside dimensions of 90 ft. by 40 ft. at North Bend, B. C., to cost about $36,000. This company will also construct a five-stall brick and steel addition to the enginehouse at Nelson, B. C., with stalls 85 ft. long. Contracts have been let to J. H. Simmons, Winnipeg, for the construction of a six-stall brick addition to the roundhouse at Alyth, Alta., and for the construction of a one-story concrete combined passenger and freight station at Trail, B. C.

Contracts have been let to W. A. Dutton, Winnipeg, Man., for the grading of extensions of line from Asquith, Sask., northwest 20 miles, and from Rosetown, Sask., northeast 21 miles. A contract for the grading of an extension from Cutknife, Sask., north to Whitford Lake, 66 miles, leaving the main line at Clandonald, has been awarded to Roosa & Wickstrand, Winnipeg. The Commercial Cartage Company, Calgary, Alta., has been awarded a contract for the grading of an extension from Cassils, Alta., 22 miles.

The Central of New Jersey has let a contract for necessary grading for the widening of its roadbed west of its Bethlehem engine terminal, and for the relocation of the public highway adjacent thereto, at Bethlehem, Pa., to cost about $55,350, to the firm of F. H. Clement & Co.

The company, on June 20, opened bids for the construc-

tion of a 6-stall roundhouse at Bethlehem, Pa., and later decided to increase the specifications to cover a 16-stall roundhouse at that point, for which bids will shortly be asked.

A contract for the construction of 600-ton four-track reinforced concrete automatic electric coaling facilities at Bethlehem, Pa., has been awarded to the Roberts & Schaefer Company, Chicago. The plant has been designed to mix mechanically various proportions of anthracite and bituminous coals.

The Chesapeake & Ohio plans extensive improvements to its property in Covington, Ky., and Cincinnati, Ohio, which will include the construction of a new bridge across the Ohio river, the renewal of the approaches to the Licking River bridge and grade crossing elimination at Covington. Additional trackage will be provided in both cities and additional platforms will be constructed at the Covington passenger station. The total cost of the improvements will be approximately $12,000,000.

The Chicago & North Western has let contracts involving the expenditure of about $200,000 for concrete piers and abutments for the 1927 bridge betterment program as follows: For the Wyoming and Black Hills divisions, to Peppard & Burrill, Minneapolis, Minn.; for the Madison division, to Duffy-Jutton Company, Milwaukee, Wis.; for the Peninsula, Lake Shore and Ashland divisions, to the Adrian Construction Company, Green Bay, Wis.; for the Southern Illinois division, to S. G. Cool, Chicago; for the Iowa division, to Gaffin & Gehri, Fond du Lac, Wis.; for the Minnesota division, to the Widell Company, Mankato, Minn. Including steel, which will be placed by company forces, these bridge replacements will cost a total of about $400,000.

Bids were received until June 27 for the remodeling of a boiler house at the Chicago Avenue terminal, Chicago, at an approximate cost of $12,000. This company plans the construction of a two-stall enginehouse at Linwood, Neb.

The Chicago, Burlington & Quincy has prepared plans for the construction of a one-story brick combined passenger and freight station at Brush, Colo., to have outside dimensions of 28 ft. by 110 ft.

The Chicago, Rock Island & Pacific has awarded a contract for the construction of a water treating plant at Kansas City, Mo., to Joseph E. Nelson & Sons, Chicago. A boiler washing plant at Hulbert, Ark., will be constructed by the F. W. Miller Heating Company, Chicago. A contract has been awarded to the Howlett Construction Company, Moline, Ill., for the construction of mechanical coaling stations at Iowa Falls, Iowa, and Mineola, Kan. A contract has been let to Joseph E. Nelson & Sons, Chicago, for the construction of a six-stall brick addition to the roundhouse at Amarillo, Tex., at an estimated cost of about $40,000.

The Cleveland, Cincinnati, Chicago & St. Louis is receiving bids for the construction of a roundhouse and terminal buildings at South Anderson, Ind., at a cost of approximately $200,000. A contract for the grading and masonry in connection with the extension of the yards at the same point has been let to the Walsh Construction Company, Davenport, Iowa.

The Hecker-Moon Company, Cleveland, Ohio, has been awarded a contract for the separation of grades at Main street, South Anderson.

A contract for the construction of a steel shop building at Cincinnati, Ohio, has been let to the Blaw-Knox Company, Blawnox, Pa., and the contract for the foundation of the structure was awarded to the Kuert Construction Company, Indianapolis, Ind.

The Erie has contracted for the work of lowering streets along the main line at Jersey City and for paving work in connection with the reduction of the street approaches. Frank Brown, Inc., of Jersey City, has the contract, and the work will cost around $90,000. The work is in connection with increased trackage which the road intends to lay in the near future.

The Grand Trunk has awarded a contract for the grading of the Pontiac Belt Line and for the grading in connection with the extension of the yards at Pontiac, Mich., to the Jones Contracting Company, Cleveland, Ohio. The total amount of excavation involved in this work is about 200,000 cu. yd.

The Great Northern has awarded a contract to George H. Moon, Bellingham, Wash., for the construction of a station at Bellingham at a cost of about $60,000.

The Gulf & Ship Island, a subsidiary of the Illinois Central, has awarded a contract for the construction of cinder and sand handling facilities at Mendenhall, Miss., to the Zitterell-Mills Company, Webster City, Iowa. This project involves the construction of sand bins, a sand dryer and compressor house and cinder pits.

The Lehigh Valley and the Pennsylvania will open bids, about July 1, for construction work in connection with the building of a joint double-track bridge across Newark Bay, which will be about 8,000 ft. long.

The Long Island has been ordered by the New York State Transit Commission (New York City) to eliminate five grade crossings at Ozone Park, N. Y., all of the crossings being within a stretch of line about one-half mile long. This is a four-track line, electrically operated; estimated total cost of the proposed work, $2,136,600.

The Louisville & Nashville has been authorized by the Interstate Commerce Commission to construct a new line from Chevrolet, Ky., to Hagans, Va., 13.87 miles and the operation under trackage right of a line of the Interstate Railroad from a point near Norton to Miller Yard, Va., about 18 miles, to connect the Eastern Kentucky division of the L. & N., with the line of the Carolina, Clinchfield & Ohio, in partial compliance with a condition imposed by the commission in connection with its authorization of a lease of the C. C. & O., by the Atlantic Coast Line and the L. & N. The estimated cost is $5,287,000.

The Mississippi River & Bonne Terre has awarded a contract for the construction of a 200-ton reinforced concrete automatic electric conveyor type coaling station at Bonne Terre, Mo., to Fairbanks Morse & Co., Chicago.

The Missouri-Kansas-Texas plans the construction of a one-story reinforced concrete pumping house and oil storage tanks at Parsons, Kans., at an estimated cost of $45,000.

Bids closed on June 27 for the construction of a freight warehouse and station at Houston, Tex., consisting of a one and two story structure with units having outside dimensions of 50 ft. by 380 ft., 50 ft. by 81 ft., and 40 ft. by 81 ft., respectively, and a reinforced concrete and steel covered shed with dimensions of 16 ft. by 402 ft.

The Missouri Pacific has awarded a contract for the construction of the walls, reinforced concrete floors and exterior terra cotta trim of the 22-story general office building at St. Louis, Mo., to the Humes-Deal Construction Company, St. Louis.

The company has let a contract to the List Construction Company, Kansas City, Mo., for grading, draining and construction of bridges and culverts on the second main track between Curtis, Ark., and Bierne, ten miles. The total project is expected to cost around $863,000.

Bids will close on July 6 for the construction of a water treating plant at Hermann, Mo., at an estimated expenditure of $30,000.

The New York Central has received bids for the alteration of the ferry terminal at Weehawken, N. J., but the award has been temporarily delayed. The alteration will consist principally in renewing the ferry bridges and the installation of modern mechanical operation. The road has asked for bids for the construction of a water intake for the power station at Port Morris, N. Y. The road has awarded a contract to the Walsh Construction Company, Davenport, a., for the construction of a 31-stall roundhouse at Harmon, N. Y., to cost approximately $470,000, for which bids closed June 14.

The New York, New Haven & Hartford has let a contract to Henry R. Kent & Co., Rutherford, N. J., for the construction of a central boiler plant at South Boston, Mass., to cost approximately $500,000.

The Northern Pacific has awarded a contract for the grading and track laying on an extension from Glendive,

Mont., to Brockway, 62 miles, to Foley Brothers, St. Paul, Minn., at a cost of about $1,000,000.

The company plans the construction of a one-story brick and concrete power plant 50 ft. by 100 ft., at Mandan, S. D. Including a coal trestle the plant will cost about $140,000. Authority has been given for rebuilding 14 stalls of the roundhouse at Glendive, Mont., at an estimated cost of $140,000.

The Oregon-Washington Railroad & Navigation Company has awarded a contract for grading and widening of cuts and embankments at a number of points between Huntington, Ore., and Pendleton, to provide for the extension of passing tracks, to Clifton, Applegate and Toole, Spokane, Wash., at an approximate cost of $150,000.

The Pennsylvania has let a contract for the construction of an overhead bridge and viaduct to eliminate a grade crossing at Rouseville, Pa., to cost about $50,000, to the Milliron Construction Company, DuBois, Pa., and a contract for drainage and paving of driveways at the Woodland Ave. freight house Cleveland, Ohio, to the Dresser Company of Cleveland. The road has awarded contracts to the T. F. Foley Construction Company, Pittsburgh, Pa., for building a bridge at Wooster, Ohio, to cost about $75,000; a bridge at New Galilee, Pa., to cost about $75,000; and an engine house extension at West Morrisville, Pa., to cost about $75,000.

The St. Louis-San Francisco's plans for the construction of a reinforced concrete viaduct over its line at Ellendale avenue, St. Louis, Mo., have been approved by the Citizen's Bond Issue Supervisory committee. The cost will be approximately $531,000 of which the Frisco will contribute $300,000.

This company will divide with the city of Springfield, Mo., the cost of a highway subway at National avenue and a viaduct at Benton avenue, estimated to require total expenditures of $90,000 and $75,000, respectively.

A contract has been let to the C. G. Kershaw Contracting Company, Birmingham, Ala., for the construction of a 24-stall frame roundhouse at Yale, Tenn., at a cost of about $75,000. A contract has also been awarded to this company for laying rail and ballasting on the new line between Aberdeen, Miss., and Aliceville, Ala., 57 miles, at a cost of approximately $200,000.

A contract has been awarded to the Roberts & Schaefer Company, Chicago, for the construction of a 400-ton four-track reinforced concrete Simplex Automatic electric coaling station at Kansas City, Mo.

The San Benito & Rio Grande Valley has been authorized by the Interstate Commerce Commission to construct an extension from a point near La Paloma, Tex., in a general southeasterly direction for about 7 miles, but has denied the application as to a further extension of 8 miles to Brownsville, Tex., which the company desired to postpone for three years.

The Southern has awarded a contract for constructing an office building at Danville, Va., to cost $35,000, to the J. P. Pettyjohn & Co., Lynchburg, Va.

The Southern Pacific has awarded a contract for the paving of team tracks and driveways at the freight station at Bakersfield, Cal., to the Union Paving Company, Bakersfield, at a cost of $18,300.

The Union Pacific plans the construction of a car repair shed at Albina, Ore., at a cost of about $50,000.

Plans have been announced by this company for the construction of a tourist lodge and necessary facilities in connection with it at Bright Angel Point, Ariz., in the Grand Canyon National Park. In addition to the main lodge present plans call for the construction of 70 sleeping lodges, a hydro-electric power plant on Bright Angel Creek, a water supply system and sewage disposal system at a total cost of about $550,000, to be completed by June 15, 1928.

The Wabash has awarded a contract for the construction of a one-story brick passenger station at Excelsior Springs, Mo., estimated to cost $25,000 to T. H. Johnson, Sedalia, Mo. A contract has been let to P. J. Hannan & Co., St. Louis, Mo., for the construction of a steel and concrete viaduct over Vandeventer avenue, St. Louis, Mo.

Supply Trade News

General

The Hyman-Michaels Company, Chicago, has appointed the Hofius Steel & Equipment Company, Seattle, Wash., its representative in Washington and the northwestern territory.

The Industrial Works, Bay City, Mich., has closed its district office at Tampa, Fla., and the district office at Atlanta, Ga., will handle all the business of Florida, Alabama, Georgia, North Carolina, South Carolina and the eastern portion of Tennessee.

The Chipman Chemical Engineering Company, Bound Brook, N. J., has established a factory at Winnipeg, Man., for the better handling of its Canadian business and especially to aid in carrying out a contract for the treatment of 2,700 miles of the Western lines of the Canadian Pacific with its weed killer.

Personal

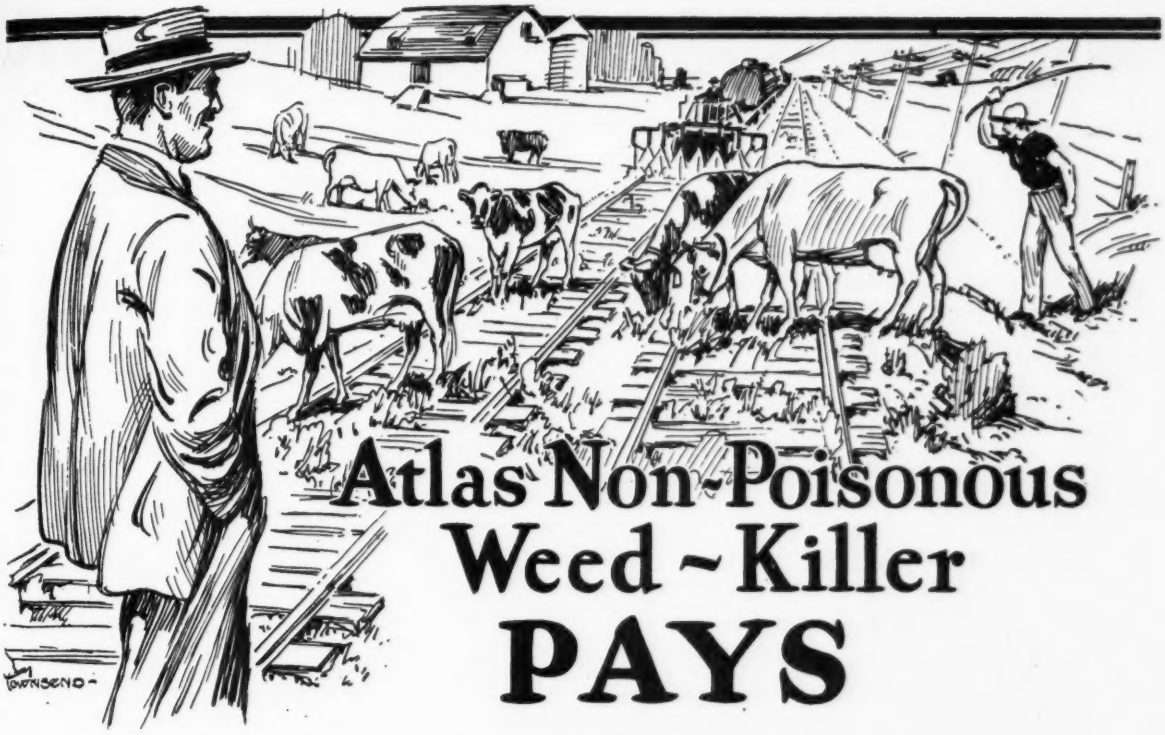
J. D. Ruttan has been placed in charge of the Canadian office of the Chipman Chemical Engineering Company, which has been opened in the Trust and Loan Building at Winnipeg, Man.

Theodore F. Merseles, president of Montgomery Ward & Co., Chicago, has resigned to become president of the Johns-Manville Corporation, New York, succeeding **H. E. Manville,** who will be elected chairman of the board.

P. William Kramer, district manager at Buffalo, N. Y., of the Air Reduction Sales Company, New York, died on May 21, at the Buffalo General Hospital, after an illness of five weeks. Mr. Kramer was 47 years of age and had been identified with the oxy-acetylene industry for nearly 20 years, of which 11 years were with the Air Reduction Sales Company. Immediately prior to his connection with this company in 1916 he was local manager of the Niagara Oxygen Company. His earlier experience had been with the Searchlight Company and other producers of gases, and as manager of a job welding shop at Binghamton, N. Y.

M. S. McNay, formerly salesmanager of the Bock Bearing Company, Toledo, Ohio, has been appointed western railway sales representative of S. K. F. Industries, Inc., with headquarters at 1140 West Washington boulevard, Chicago. **Earle M. Harshberger** has become association with the company in New York, where he will handle railroad and engineering sales in the territory east of Pittsburgh. Mr. Harshberger was born in Ladoga, Ind., in April, 1887, and was educated at Wabash and Purdue Universities. He entered the service of S. F. Bowser & Co., Ft. Wayne, Ind., manufacturers of oil storage equipment in 1915 and after remaining at the home office for three years was transferred to the Chicago office where he was in sales work for two years when he was transferred to St. Louis as assistant district manager of that territory, specializing in railroad work. A year later he returned to the home office as manager of the railroad department and of the government sales department, remaining in this position for five years following which he was appointed district manager of the New York office with special attention to railroad work, which position he was holding at the time of his joining the organization of S. K. F. Industries, Inc.

Electric Portable Hoists.—The Sullivan Machinery Company, Chicago, has issued a second edition of its bulletin No. 96-G, a 16-page booklet in which are described one double-drum and two single drum electric hoists. Attention is called to the various kinds of work for which these hoists may be used such as spotting railroad cars, operating derrick and for car haulage in mines and quarries, as well as for strictly hoisting service. Full details of the different machines are given.



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Chipman Spray trains are provided with both Atlas "A" and Atlas "NP". A turn of one valve will change the spray.

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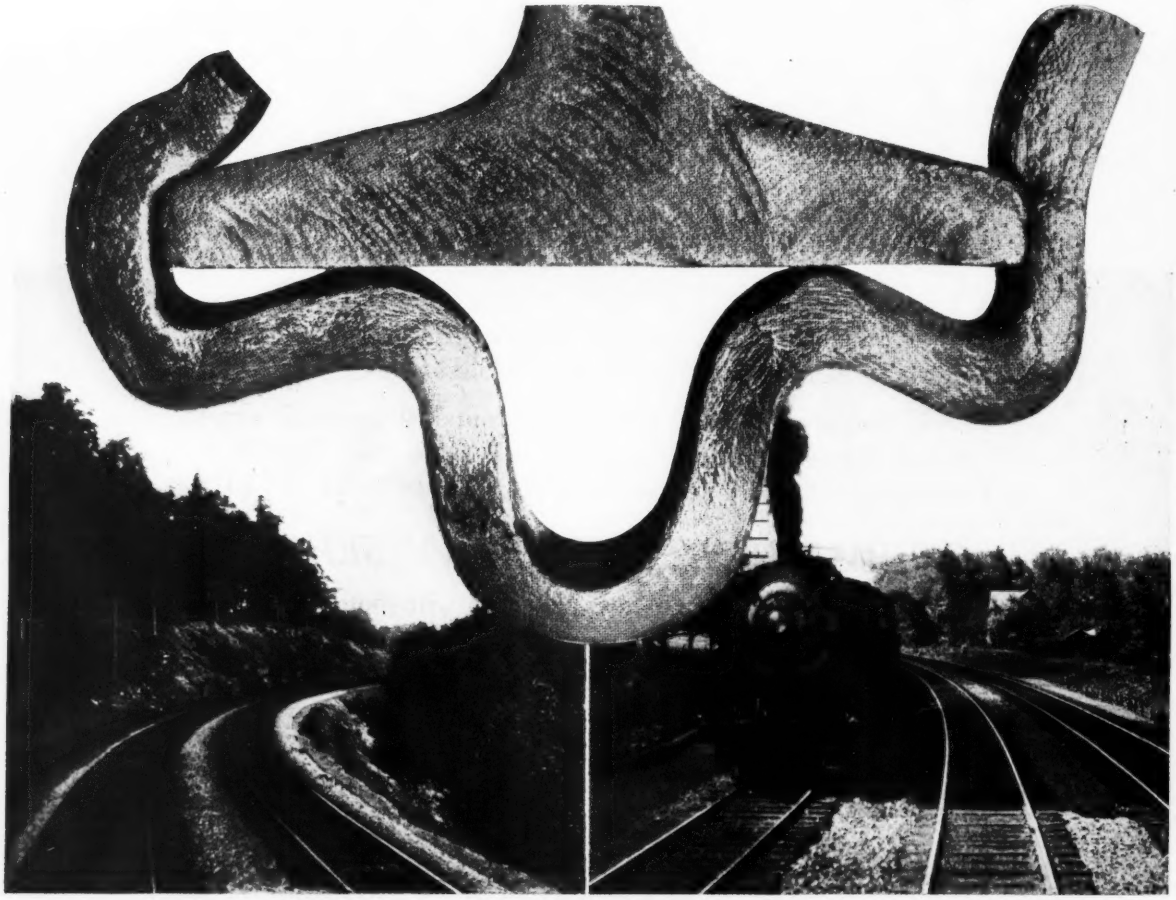
A COMPARATIVE TEST will quickly demonstrate their ability to hold under any traffic condition.



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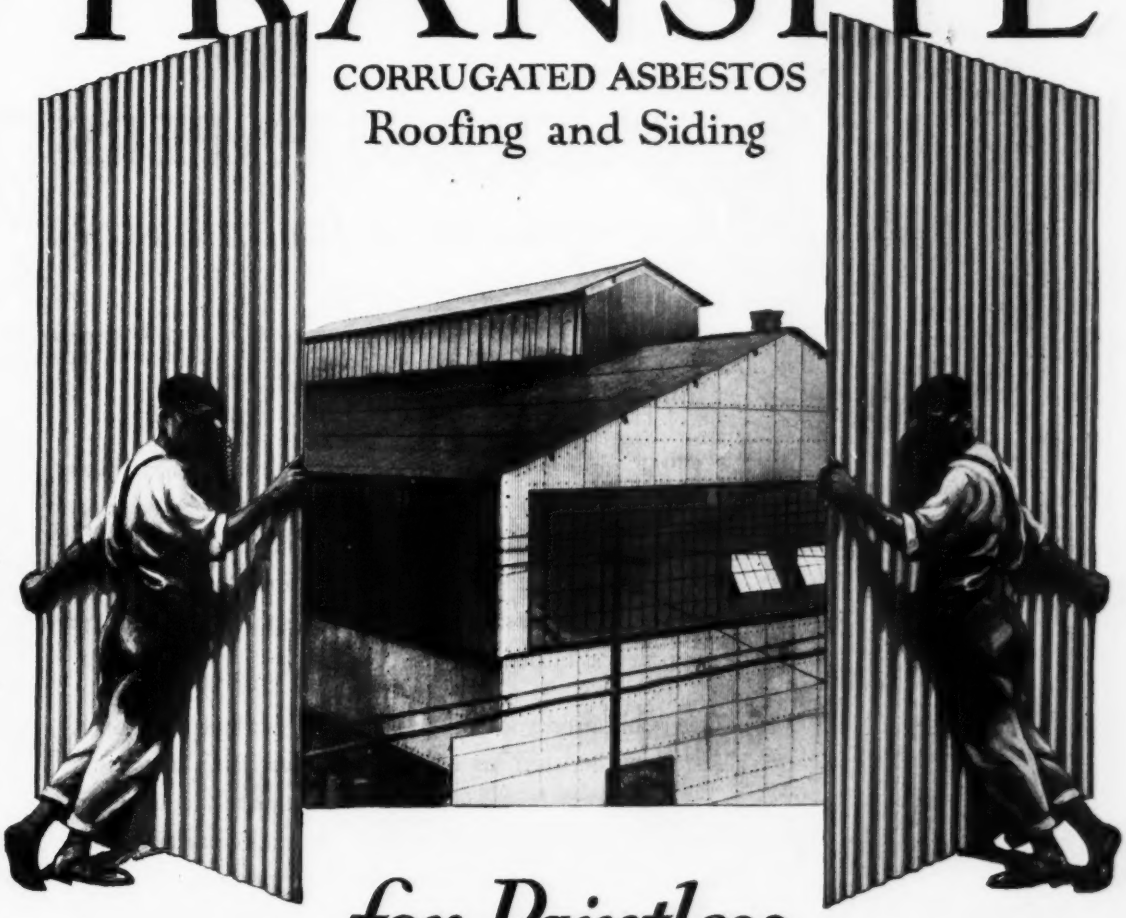

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PERMANENCE

NO paint needed for these enduring corrugated slabs of asbestos and Portland cement, and no replacements.

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Deduct the cost of paint and repairs and you'll find it the most economical roofing of its type.

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Bituroc is a natural bituminous sandstone quarried and pulverized at our plant at Summit, Hardin County, Kentucky.

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TRACK AND TURNOUT ENGINEERING

By C. M. KURTZ

Mr. Kurtz has written this book for the railroad engineer from the result of twenty-five years' practical experience.

Track and Turnout Engineering is of practical value to every man to whom the business of track layout is an everyday problem. The young engineer or transit man, green in track work experience, should have this book. Division Engineers of Maintenance of Way Department would do well to see that all their subordinates in both field and office were provided with copies.

The problems shown are taken from actual practice and the mathematical treatment outlined and demonstrated is tried and practical treatment.

A. R. E. A. definitions are specified throughout the text as well as full explanation of A. R. E. A. exceptions and omissions. All terms relating to track layout from a single track to a yard layout are given in complete detail. Solutions of vertical curve problems are given in three ways, all outlined in a simple manner and thoroughly demonstrated.

New simple formulae are given for obtaining the elevation of any point on a vertical curve. Formulae for computing slip-switches, angles of frog, moveable point crossings, location of frogs for wye between curved and tangent lines—in fact every computing problem which may arise is treated in such a way as to be readily accessible and clearly understood.

The formulae are illustrated and supplemented by over 116 drawings showing the best of accepted designs for layout. Logarithmic tables and tables computing the inside and outside of turnout curves should prove invaluable to students as well as experienced engineers who realize the importance of having a large body of information for ready use in compact form.

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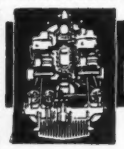

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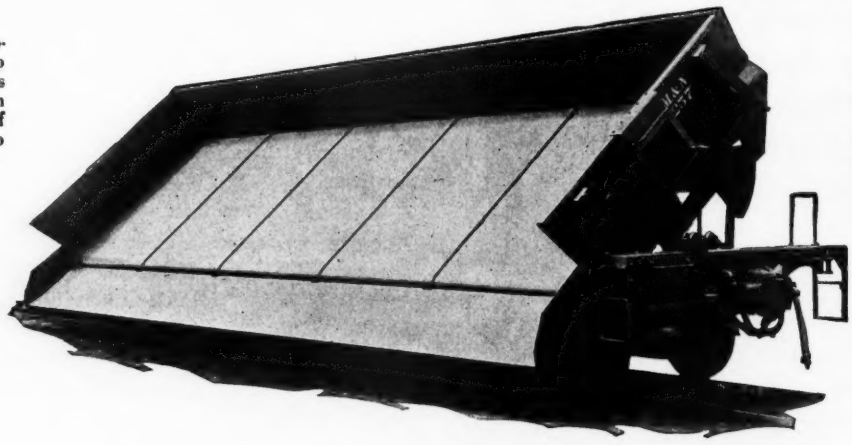

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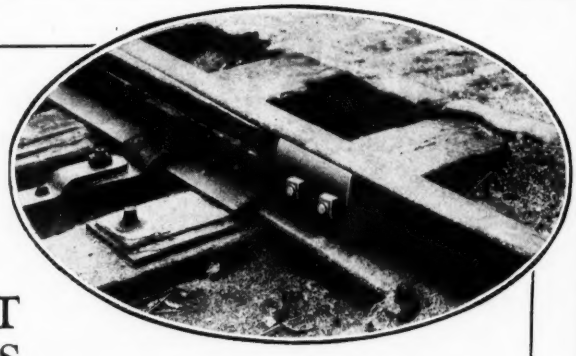

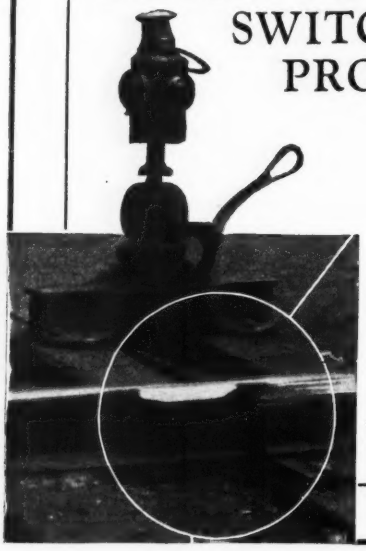

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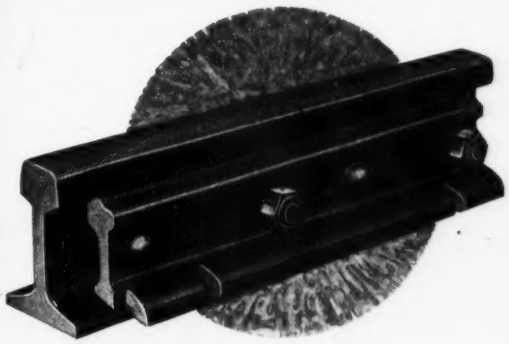

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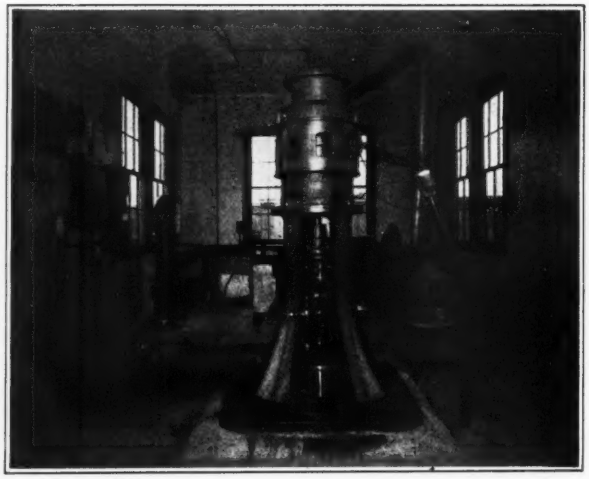

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BLOXHAM
Track Liners

RE&M 7-Gray

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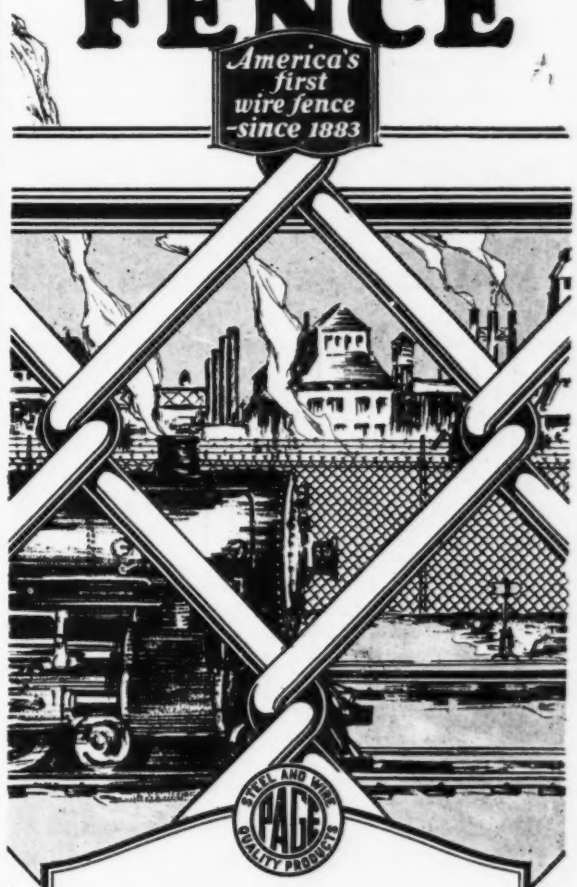

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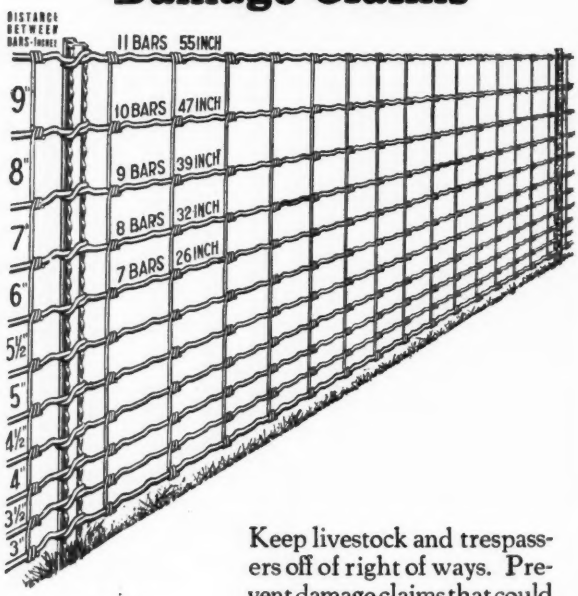

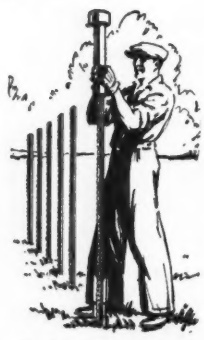

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Select American Railroad Fence and Banner Steel Posts and you have the most practical protection that could be provided.

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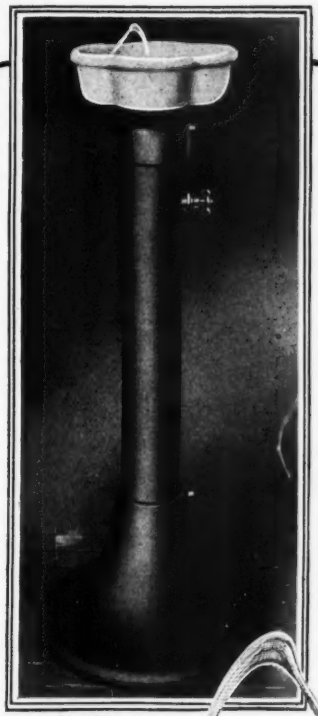

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One of the many types for railroad use. Cover can be raised to make connections and then bolted to the floor. Two-stream projector, automatic stream control!

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On the largest railroad systems of the country, in shop, terminal, office or corridors, you'll find Halsey Taylor Drinking Fountains. Known for years as the most sanitary and practical side-stream type made, these fountains will meet

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Automatic Stream Control
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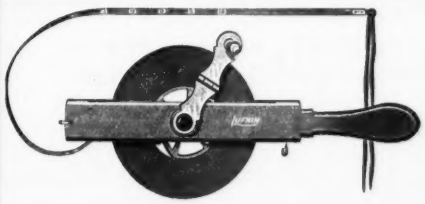

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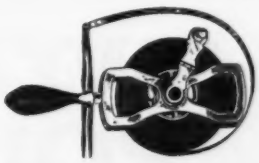

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Most popular for rough survey and maintenance work.
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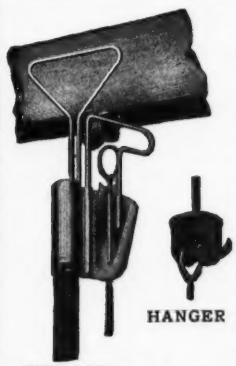

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Can now be taken down and replaced by one man from the ground.
No more need of sending a crew of 3 or 4 men over your road with a long ladder, and climbing to the cross arm.
No more tangling of tell-tales.
BRONZE HANGERS — no corrosion or rust — everlasting — TELL-TALES of spring brass rods and treated rope, most resistant to bending.
You can eliminate almost your entire labor and replacement costs and make your bridge and tunnel warnings 100% efficient.
Avoid death and injuries to employees.

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We are qualified by organization and experience to give you service. Write for our literature.

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Electrically Driven, No Friction Discs, Gear Shifts or Clutches
Four men Can Easily Remove Car from Tracks

THE EUCLID ELECTRIC & MFG. CO.
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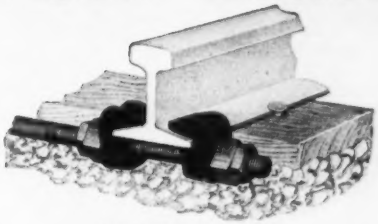
"Anchor" Track Braces



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Carry a few dozen track braces on every work train or wreck outfit. They are the quickest track repair that is possible. Send for full description.

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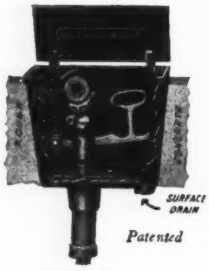

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Full loads and continuous performance cut down rehandling costs. You are taking no chance when you use Owen Buckets—"They get a Mouthful at Every Bite."

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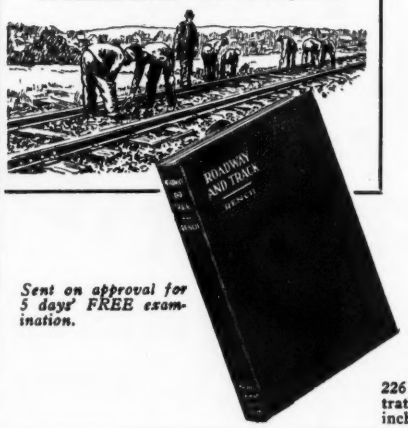

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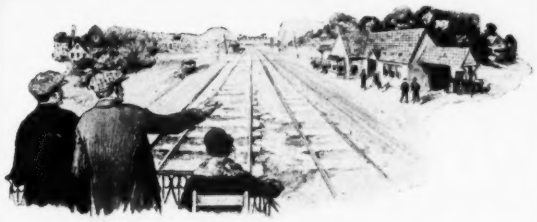

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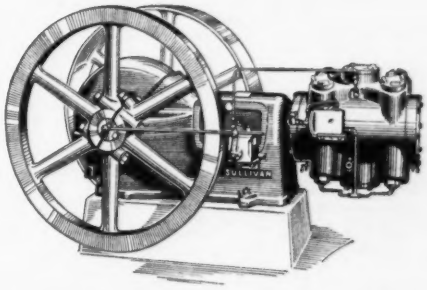
10 Features of the "WG-6" Mean Better Air Power Service



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saves power by automatically interrupting compression whenever the desired pressure is reached; enabling the machine to run under no load until air is needed again.

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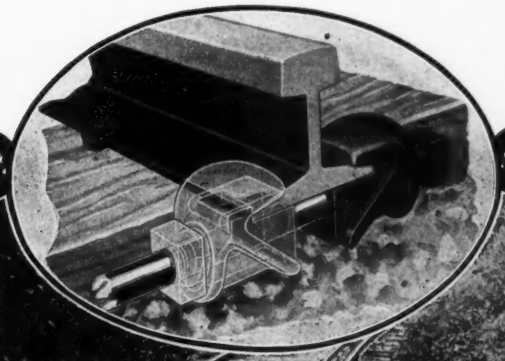

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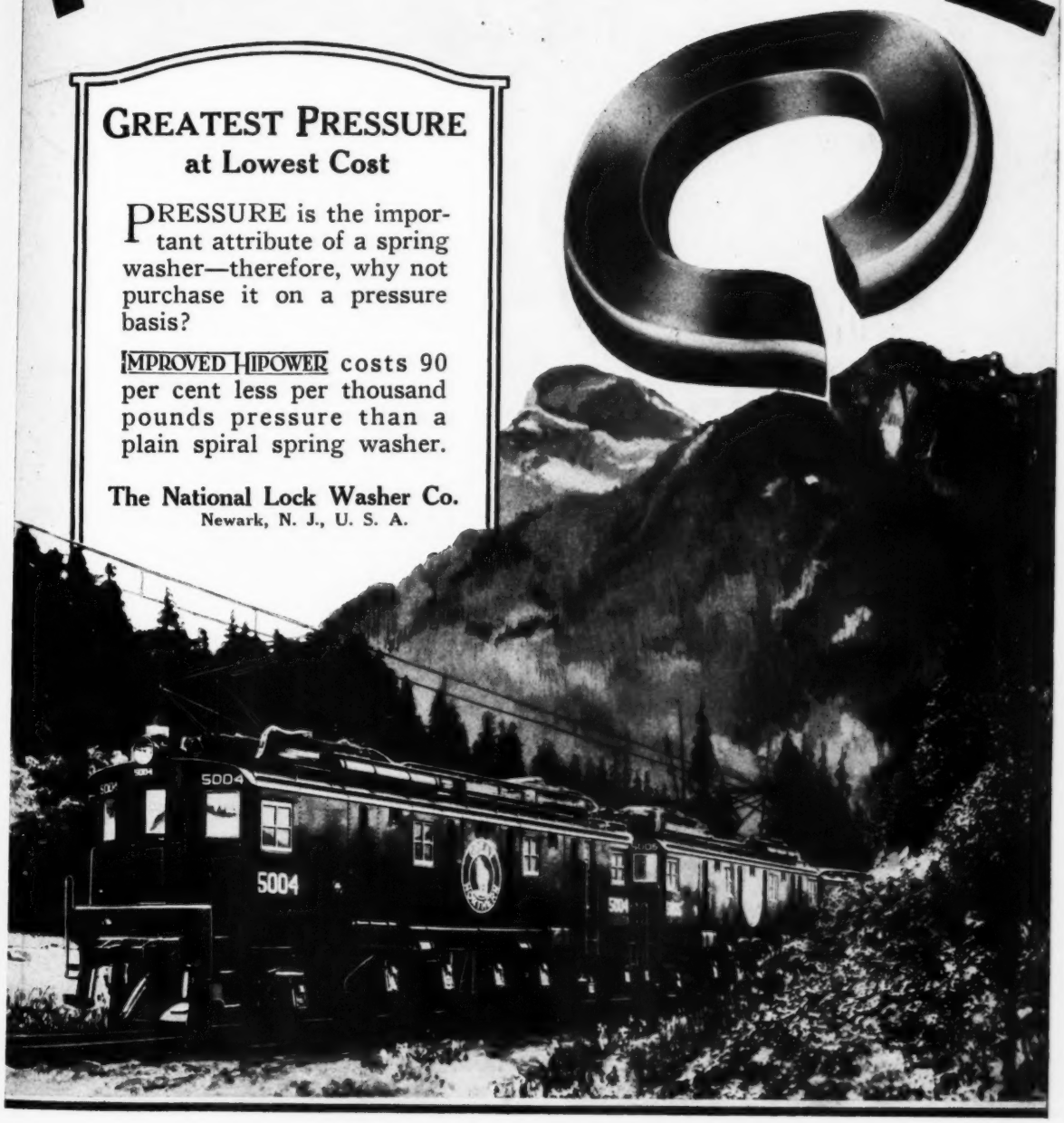

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